SRI VENKATESWRA UNIVERSITY COLLEGE OF ENGINEERING::TIRUPATI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

R20 - REGULATIONS

SCHEME AND SYLLABUS

INSTITUTE MISSION, VISION

MISSION

- To be recognized as a premier institution offering Engineering Education programs, training human resources oriented to problem solving and system development.
- To carry out research in Engineering and Technology relevant to all segments of society
- To assume leadership in sustainable technological growth of the Indian society
- To be a natural destination for excellence and diversity in thought and practice

VISION

The Vision of Sri Venkateswara University College of Engineering is to be the leader in the creation and development of globally competitive human capital in Engineering Education for Technological, Economical and Social Enrichment of the Society, through its open and flexible Academic Programmes.

DEPARTMENT MISSION, VISION

MISSION

- To provide the necessary domain expertise and infrastructure to the students
- To make available the advanced laboratories, application oriented engineering principles for students and researchers
- To offer research and industry orientation to become successful service oriented technocrats

VISION

The department aims at catering to the needs and aspirations of the people and their development, reach to the world through state of art technologies of Electrical and Electronics Engineering and to serve the society at large.

PROGRAM OUTCOMES	
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design / Development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research – based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES	
PSO1	Generate, Transmit, Distribute, Control and Utilize electrical power effectively by analyzing and applying appropriate techniques and hardware/software tools.
PSO2	Develop different electrical and electronics circuits/models using semiconductor and Power Electronic devices considering the environmental and societal needs.

PROGRAM EDUCATIONAL OBJECTIVES	
PEO1	Graduates will, demonstrate professional behavior to cater the global needs of the industry and society.
PEO2	Graduates will pursue higher education to upgrade their professional and research Skills and inculcate the attitude of lifelong learning.
PEO3	Graduates will develop the qualities like creativity, leadership, team work and professional ethics contributing to the societal growth.

SCHEME

R20 - REGULATIONS

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B.Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	I- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	**MA101**	**BST**	Mathematics-I	3	1	-	4	4	40	60	100
2	**PY102**	**BST**	Modern Physics	3	1	-	4	4	40	60	100
3	**CS103**	**BET**	Programming for problem solving	2	1	-	3	3	40	60	100
4	**CE104**	**BET**	Engineering Mechanics	3	1	-	4	4	40	60	100
5	**ME105**	**BEL**	Workshop/ Manufacturing Practice	-	-	3	3	1.5	40	60	100
6	**CS106**	**BEL**	Programming for problem solving lab	-	-	3	3	1.5	40	60	100
7	**CE107**	**MCT**	Environmental Science	4	-	-	4	0	100	-	100
Total				**15**	**04**	**06**	**25**	**18**	**340**	**360**	**700**

Category	Credits
Basic Science Courses	8
Engineering Science Courses	10
Environmental Science	0
TOTAL CREDITS	18

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B.Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	II- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1	**MA201**	**BST**	Mathematics-II	3	1	-	4	4	40	60	100
2	**CY202**	**BST**	Engineering Chemistry	3	1	-	4	4	40	60	100
3	**EN203**	**HST**	English	2	-	-	2	2	40	60	100
4	**EE204**	**BET**	Electrical Circuits	3	1	-	4	4	40	60	100
5	**ME205**	**BEL**	Engineering Graphics and Design	2	-	3	5	3.5	40	60	100
6	**EN206**	**HSL**	English Communication Lab	-	-	3	3	1.5	40	60	100
Total				**13**	**03**	**06**	**22**	**19**	**240**	**360**	**600**

Category	**Credits**
Basic Science Courses	8
Engineering Science Courses	7.5
Humanities and social science	3.5
TOTAL CREDITS	19

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502											
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System**(R-20 Regulations)**											
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21											
	III- SEMESTER											
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**MA301B**	**BST**	Mathematics –III	3	-	-	3	3	40	60	100
2.	**EE302C**	**BET**	Electro Magnetic Fields	3	-	-	3	3	40	60	100
3.	**EE303C**	**PCT**	Network Analysis	3	1	-	4	4	40	60	100
4.	**EE304C**	**PCT**	D.C. Machines and Transformers	3	1	-	4	4	40	60	100
5.	**EE305C**	**PCT**	Analog Electronics	3	-	-	3	3	40	60	100
6.	**EE306L**	**PCL**	Electrical Circuits and Networks Lab	-	-	3	3	1.5	40	60	100
7.	**EE307L**	**PCL**	D.C. Machines and Transformers Lab	-	-	3	3	1.5	40	60	100
8.	**EE309S**	**SC1**	Computer Skills	1	-	2	3	2	40	60	100
9.	**MC310A**	**MCT1**	Constitution of India	2	-	-	2	0	100	-	100
Total				**18**	**02**	**08**	**28**	**22**	**420**	**480**	**900**

Category	**Credits**
Basic Science Courses	3
Engineering Science Courses	3
Professional Core Course	14
Skill Oriented Course	2
TOTAL CREDITS	22

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	IV- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EE401C**	**PCT**	Power systems-I	3	1	-	4	4	40	60	100
2.	**EE402C**	**PCT**	Induction Motors and Synchronous Machines	3	1	-	4	4	40	60	100
3.	**HS403C**	**HST**	Managerial Economics and Accountancy	3	-	-	3	3	40	60	100
4.	**EE404C**	**PCT**	Digital Electronics	3	-	-	3	3	40	60	100
5.	**EE405C**	**PCT**	Signals and Systems	3	-	-	3	3	40	60	100
6.	**EE406L**	**PCL**	Induction Motors and Synchronous Machines Lab	-	-	3	3	1.5	40	60	100
7.	**EE407L**	**PCL**	Analog and Digital Electronics Lab	-	-	3	3	1.5	40	60	100
8.	**EE409S**	**SC2**	Python Programming	1	-	2	3	2	40	60	100
9.			NCC / NSS / NSO Activities	60 Hrs			2	-	-	-	-
Total				**16**	**02**	**08**	**28**	**22**	**320**	**480**	**800**

Note: **1.** Community Service Internship (Mandatory) Throughout the semester (45 Hrs, 1.5 – credits, 100 – Marks to be given by mentors) – (Performance will be Reflected in V Semester).

2. NCC / NSS / NSO –Students should acquire at least 45 Hrs out of 60 Hrs from I semester to IV Semester.

Category	**Credits**
Professional Core Course	17
Humanities and social science	3
Skill Oriented Course	2
NCC / NSS / NSO Activities	0
TOTAL CREDITS	22

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	V- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EE501C**	**PCT**	Power systems-II	3	-	-	3	3	40	60	100
2.	**EE502C**	**PCT**	Linear Control Systems	3	-	-	3	3	40	60	100
3.	**EE503C**	**PCT**	Power Electronics	3	-	-	3	3	40	60	100
4.	**EE504C**	**PET**	Professional Elective - I	3	-	-	3	3	40	60	100
5.	**EE505C**	**OET**	Open Elective – I (MOOCs)	3	-	-	3	3	100	-	100
6.	**EE506L**	**PCL**	Control Systems Lab	-	-	3	3	1.5	40	60	100
7.	**EE507L**	**PCL**	Power Electronics Lab	-	-	3	3	1.5	40	60	100
8.	**EE508S**	**SC3**	MATLAB Laboratory	1	-	2	3	2	40	60	100
9.	**MC509A**	**MCT2**	Universal Human Values (Mandatory Course)	2	-	-	2	0	100	-	100
10.	**EE510**	**Internship**	Community Service Internship	45 Hrs				1.5	100	-	100
Total				**18**	**-**	**08**	**26**	**21.5**	**580**	**420**	**1000**

Professional Elective – I

i. Wind and Solar Energy Systems
ii. Electrical Distribution System
iii. Electrical Safety

Category	**Credits**
Professional Core Course	12
Professional Elective courses	3
Open Elective Course/Job oriented elective	3
Skill Oriented Course	2
Universal Human Values	0
Community Service Internship	1.5
TOTAL CREDITS	21.5

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System**(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	VI- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EE601C**	**PCT**	Power system Analysis	3	1	-	4	4	40	60	100
2.	**EE602C**	**PCT**	Electrical and Electronics Measurements	3	-	-	3	3	40	60	100
3.	**EE603C**	**PCT**	Micro Processors and Micro Controllers	3	-	-	3	3	40	60	100
4.	**EE604C**	**PCT**	Utilization of Electrical Power	3	-	-	3	3	40	60	100
5.	**EE605C**	**PET**	Professional Elective - II	3	-	-	3	3	40	60	100
6.	**EE606C**	**OET**	Open Elective – II (MOOCs)	3	-	-	3	3	100	-	100
7.	**EE607L**	**PCL**	Microprocessors and Micro Controllers Lab	-	-	3	3	1.5	40	60	100
8.	**EE608L**	**PCL**	Electrical and Electronics Measurements Lab	-	-	3	3	1.5	40	60	100
9.	**EE609S**	**SC4**	Java Programming	1	-	2	3	2	40	60	100
10.	**MC610 A**	**MCT2**	Professional Ethics in Engineering (Mandatory Course)	2	-	-	2	0	100	-	100
Total				**21**	**01**	**08**	**30**	**24**	**520**	**480**	**1000**

Professional Elective – II

i. Advanced Control Systems
ii. Energy Auditing and Management
iii. Special Machines

Note: Summer Industrial Internship (Mandatory) Two months (Duration - 60 Hrs, 3 – credits, 100 – Marks to be given by internal evaluation committee) – during summer vacation (Performance will be reflected in VII Semester, Online / Offline mode

Category	Credits
Professional Core Courses	16
Professional Elective Courses	03
Open Elective Course / Job Oriented Elective	03
Professional Ethics in Engineering	00
Skill Oriented Course	02
Total Credits	**24**

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	VII- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EE701C**	**PCT**	Power System Protection	3	-	-	3	3	40	60	100
2.	**EE702C**	**PET**	Professional Elective – III	3	-	-	3	3	40	60	100
3.	**EE703C**	**PET**	Professional Elective – IV	3	-	-	3	3	40	60	100
4.	**EE704C**	**PET**	Professional Elective - V	3	-	-	3	3	40	60	100
5.	**EE705C**	**OET**	Open Elective – III (MOOCs)	3	-	-	3	3	100	-	100
6.	**EE706C**	**OET**	Open Elective – IV (MOOCs)	3	-	-	3	3	100	-	100
7.	**EE707 L**	**PCL**	Power System Simulation Lab	-	-	3	3	1.5	40	60	100
8.	**EE708S**	**SC5**	IoT Lab	1	-	2	3	2	40	60	100
9.	**EE709I**	**Internship**	Summer Industrial Internship	2 Months			-	3	100	-	100
Total				**19**	**-**	**05**	**24**	**24.5**	**540**	**360**	**900**

Professional Elective – III	**Professional Elective – IV**	**Professional Elective – V**
i. Electrical Vehicles ii. Flexible AC Transmission Systems iii. Restructured Power Systems	i. Power System Operation and Control ii. Power Semiconductor Controlled Drives iii. Power Quality	i. HVDC Transmission ii. High Voltage Engineering iii. Smart Grid

Category	**Credits**
Professional Core Course	4.5
Professional Elective courses	9
Open Elective Course/Job oriented elective	6
Summer Industrial Internship	3
Skill Oriented Course	2
TOTAL CREDITS	24.5

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering), w.e.f. 2020-21										
	VIII- SEMESTER										
S.No	**Course Code**	**Category**	**Course Title**	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EEPROJ801**	**Major project**	Project Work and Internship	-	-	24	24	12	40	60	100
Total				**-**	**-**	**24**	**24**	**12**	**320**	**480**	**800**

Category	Credits
I- SEMESTER	18
II- SEMESTER	19
III- SEMESTER	22
IV- SEMESTER	22
V- SEMESTER	21.5
VI- SEMESTER	24
VII- SEMESTER	24.5
VIII- SEMESTER	12
TOTAL CREDITS	**163**

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering) (HONOURS DEGREE)										
S.No	**Course Code**	**Category**	**Course Title**					No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EEHN01**	**HON**	Electrical Machine Design	3	1	-	4	4	40	60	100
2.	**EEHN02**	**HON**	Advanced Power System Protection	3	1	-	4	4	40	60	100
3.	**EEHN03**	**HON**	Digital Control Systems	3	1	-	4	4	40	60	100
4.	**EEHN04**	**HON**	Advanced Power Electronics	3	1	-	4	4	40	60	100
5.	**EEHN05**	**HON**	Hybrid Electrical Vehicles	3	1	-	4	4	40	60	100
6.	**EEHN06**	**HON**	Industrial Applications of Electrical Engineering	3	1	-	4	4	40	60	100

Note: A student shall register for 4 (Four) Subjects from the above list, as per the R20-Regulations for B.Tech (HONOURS) Degree.

	SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI – 517 502										
	Department of Electrical and Electronics Engineering-Scheme of Instruction- Choice Based Credit System **(R-20 Regulations)**										
	B. Tech (Electrical and Electronics Engineering) (MINOR DEGREE)										
S.No	**Course Code**	**Category**	**Course Title**					No. of Credits	Scheme of Evaluation		
				Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
1.	**EEMN01**	**MIN**	Electrical Circuits and Networks	3	1	-	4	4	40	60	100
2.	**EEMN02**	**MIN**	Electrical Machines	3	1	-	4	4	40	60	100
3.	**EEMN03**	**MIN**	Power Systems	3	1	-	4	4	40	60	100
4.	**EEMN04**	**MIN**	Control Systems	3	1	-	4	4	40	60	100
5.	**EEMN05**	**MIN**	Power Electronics	3	1	-	4	4	40	60	100
6.	**EEMN06**	**MIN**	Electronics Engineering	3	1	-	4	4	40	60	100

Note: A student shall register for 4 (Four) Subjects from the above list, as per the R20-Regulations for B.Tech (MINOR) Degree.

SYLLABUS

R – 20 REGULATIONS

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING: TIRUPATI
DEPARTMENT OF ELECTICAL AND ELECTRONICS ENGINEERING
R20 REGULATIONS
SYLLABUS

I – SEMESTER

MA101	MATHEMATICS –I	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. Analyze differential equations and solve them
2. Apply differential equations to engineering problems.
3. Use transformation to convert one type into another type presumably easier to solve.
4. Use shift theorems to compute the Laplace transform, inverse Laplace transform and the solutions of second order, linear equations with constant coefficients.
5. Solve an initial value problem for an n^{th} order ordinary differential equation using the Laplace transform.
6. Expand functions as power series using Maclaurin's and Taylor's series
7. Optimize the problems related to OR, Computer science, Probability and Statistics
8. Draw an approximate shape by the study of some of its important characteristics such as symmetry, tangents, regions enclosing curve tracing method to find length, area, volume.
9. Use multiple integral in evaluating area and volume of any region bounded by the given curves.

UNIT I

Differential Equations: Linear differential equations of second and higher order with constant coefficients-particular integrals-homogeneous differential equations with variable coefficients-method of parameters-simulation equations.

UNIT II

Laplace Transforms I: Laplace transforms of standard functions-inverse transforms-transforms of derivatives and integrals-derivatives of transforms-integrals of transforms.

UNIT III

Laplace Transforms II: Transforms of periodic functions-convolution theorem-applications to solution of ordinary differential equations.

UNIT IV

Calculus: Roll's and Mean value theorems - Taylor's and Maclaurins's series-maxima and minima for functions of two variables - Infinite series - Convergence Tests series of positive terms - comparison, Ratio tests - Alternating series - Leibnitz's rule - Absolute and conditional convergence.

UNIT V

Multiple Integrals: Curve tracing (both Cartesian and polar coordinate) - Evaluations of double

and Triple integrals-change of order of integrations-change of variables of integrations-simple applications to areas and volumes.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
4. Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

PY 102	MODERN PHYSICS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. Develop appropriate competence and working knowledge of laws of modern Physics in understanding advanced technical engineering courses
2. Understand the quantum mechanics and ultimately the quantum behavior of charged particles when they are in motion.
3. Identify and apply appropriate analytical and mathematical tools of Physics in solving Engineering problems
4. Apply knowledge of band theory in the area of electronics and understanding the basic electron transportation phenomenon in microdevices.
5. Understand the principles in electrostatics and electromagnetics and magnetic properties of materials.
6. Understand size depended properties of nano-dimensional materials and their effective utilization in making nano- and micro-devices for further microminiaturization of electronic devices.
7. Think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
8. Learn the basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis.
9. Provide multidisciplinary experiences throughout the curriculum.

UNIT I

Quantum Mechanics : Wave – Particle duality – de Broglie Concept of Matter Waves – Properties of Matter Waves – Davison and Germer Experiment – G.P. Thomson Experiment – Heisenberg's Uncertainty Principle – Schrödinger's Time Independent and Time Dependent Wave equation – Significance of Wave Function – Electron in an Infinite Square Potential Well – Probability Densities and Energy Levels.

UNIT II

Band Theory of Solids : Classical Free Electron Theory of Metals – Success and Failures – Quantum Free Electron Theory – Fermi Factor – Electron in Periodic Potential – Bloch Theorem – Kronig – Penney Model – Distinction between Metals , Insulators and semiconductors- Energy Band Structures.

UNIT III

Semiconductors – Introduction- Intrinsic and Extrinsic Semiconductors – Density of states – Carrier Concentrations at Equilibrium – Hall Effect. PN Junction Diode – Energy Band Diagram – Forward and Reverse Bias- Current – Voltage characteristics – Applications- Zener Diode – Light Emitting Diode- Photo diode -Solar Cell – Semiconductor Laser.

UNIT IV

Electromagnetism and magnetic properties of Materials:

Laws of Electrostatistics- Electric Current- Laws of Magnetism- Ampere`s, Faraday`s laws-

Maxwell Equations – Polarization – Permeability and dielectric constant- Polar and non-polar Dielectrics, Clausius-Mossotti equation, Applications of Dielectrics.

Magnetization – Permeability and Susceptibility- Classification of Magnetic Materials, Ferromagnetism-Magnetic Domains and hysteresis, Applications of ferromagnetic materials.

UNIT V

NanoPhysics and Nanotechnology : Introduction to Nanomaterials –Properties: Optical Properties – Quantum Confinement – Electrical properties. Synthesis of Nanomaterials: Ball milling, Arc deposition method – Chemical Vapour Deposition-Pulsed laser deposition. Characteristics of C^{60} (Zero dimensional), Carbon Nanotubes (One Dimensional) and Graphene(Two Dimensional). Applications of Nanomaterials. 10 hrs.

Text Books / Reference Books:

1. R.K.Gaur and S.L.Gupta ``Engineering Physics" Sultan and Chand Pub., New Delhi
2. S.P.Basava Raju `` A Detailed Text Book of Engineering Physics" Sole Distributors, Subhash Stores Book Corner, Bangalore
3. HitendraK.Malik and A.K.Singh ``Engineering Physics" Tata MC Graw Hill Education PVt.Ltd., New Delhi
4. M.N.Avadhanulu and P.G.Kshirsagar ``A Textbook of Engineering Physics`` S.Chand and Company Pvt.Ltd., New Delhi
5. John Allison, ``Electronic Engineering Materials and Devices" TataMcGraw Hill Publications.
6. B.L Theraja, "Modern physics", S.Chand& Company.
7. V. Raghavan "Material Science", Tata McGraw Hill Publications.
8. M.S.RamachandraRao and Shubra Singh, ``Nanoscience and Nanotechnology`` Wiley India Pvt.Ltd, New Delhi

CS 103	PROGRAMMING FOR PROBLEM SOLVING	3 Credits
Sessional Marks: **40**	**2L:1T:0P**	End Examination Marks: **60**

Course Objectives:

1. To acquire problem solving skills
2. To be able to develop flowcharts and algorithms for the given problem
3. To learn how to write modular programs in C
4. To enable to use arrays, pointers, strings and structures in solving problems.
5. To explain the difference between object-oriented programming and procedural programming.
6. To understand principles of object-oriented programming.

UNIT-I

Problem Solving: Problem solving techniques, Computer as a problem solving tool, Programming Languages – Machine Language, Assembly Language, Low and High-Level Languages, Procedural and Object-Oriented Languages. Algorithm definition, Features, Criteria, Flowchart definition, Basic symbols, Sample flowcharts, Problem solving aspects, Efficiency of algorithms.

Basics of C: Structure of a C program, C tokens, Keywords, Identifiers, Basic data types and sizes, Constants, Variables, Operators in C, Operator Precedence and Associativity, Expressions, Type conversions, Basic input/output statement, Sample programs.

UNIT-II

Conditional Statements: Selection statements, Decision making within a program, Simple if statement, if-else statement, Nested if-else, if-else ladder and switch-case. Iterative statements: while-loop, do-while loop, for loop, Nested loops, Infinite loops, goto, break and continue statements, Sample programs.

Functions: Introduction to modular programming and functions, Basics, Standard Library of C functions, Prototype of a function, Parameter passing, User defined functions, Recursive functions, Passing arguments to a function: Call by reference, Call by value, Storage Classes in a single source file, Scope rules, Header files, C Pre-processor.

UNIT-III

Arrays: Introduction to arrays, Definition, Declaration, Storing elements, Accessing elements, One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array, Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix, Passing array to functions, String fundamentals, String manipulations, Standard library string functions.

Pointers: Definition of pointer, pointer type declaration, pointer assignment, pointer initialization, Pointer arithmetic, Functions and Pointers, Dangling memory, Character pointers and functions, Pointers to pointers, Arrays and Pointers, Pointer arrays, Pointers and structures, Dynamic memory management functions.

UNIT-IV

Structures: Structures declaration, Structure variables, Initialization of structures, Accessing structures, Nested structures, Arrays of structures, Structures containing arrays, Structures and functions, Pointers to structures, Self-referential structures, Unions, Typedef, Bit-fields.

File Processing: Concept of Files, Text files and binary files, File opening in various modes and closing of a file, Reading from a file, Writing onto a file.

UNIT V

Introduction to Object-Oriented Programming (OOP): Need for OOP, Principles of OOP, Basics of C++ Programming, Operator Overloading, Function Overloading, Inheritance: Derived classes, Protected access specifier, Derived class constructors, Overriding member functions, Class hierarchies, Public and Private inheritance, Multiple inheritance.

Course Outcomes: At the end of the course, student will be able to

1. Develop and test programs in C and correct syntax and logical errors.
2. Implement conditional branching, iteration and recursion.
3. Decompose a problem into functions and synthesize a complete program.
4. Use arrays, pointers, strings and structures to formulate algorithms and programs
5. Use files to perform read and write operations.
6. Handle programming assignments based on class, abstraction, encapsulation, overloading and inheritance

Text Books

1. Ashok N Kamthane, Amit Ashok Kamthane, Programming in C, 3rd Edition, Pearson Education, 2019.
2. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson Education, 2019.
5. Herbert Schildt,The Complete Reference C++, 4th Edition, Tata McGraw-Hill.

Reference Books

1. C Programming-A Problem Solving Approach, Forouzan, Gilberg, Cengage.
2. Programming with C, Bichkar, Universities Press.
3. Programming in C, ReemaThareja, OXFORD.
4. C by Example, Noel Kalicharan, Cambridge.
5. The C++ Programming Language, Bjarne Stroustrup, 3rd Edition, Pearson Education.
6. Problem solving with C++: The Object of Programming, 9th Edition, Walter Savitch, Pearson Education.

CE 104	ENGINEERING MECHANICS	Credits: 4
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, student will be able to

1. apply the basic knowledge of force system.
2. know the types of supports occur in civil engineering structures
3. know the geometrical properties of different cross sections.
4. understand different types of stresses and strains, elastic constants.
5. understand the behavior of different internal forces under different types of loading.

UNIT I

STATICS : Basic concepts – System of force, Concurrent and non-concurrent coplanar and non- coplanar forces – Resultant – Moment of force and its application – Couples and resultant of force systems – Equilibrium of systems of forces – Free body diagrams, Equations of equilibrium of coplanar systems and spatial systems.

UNIT II

Analysis of plane trusses: Types of supports – Types of trusses – Analysis of trusses using method of joints and method of sections.

UNIT III

CENTRE OF GRAVITY AND MOMENTS OF INERTIA: Theory of Pappus – Centroids of composite figures – Areas of gravity of bodies – Moment of inertia – Parallel and perpendicular axis theorems – Moments of inertia of composite areas (rolled and built up sections) – Radius of gyration of areas.

UNIT IV

SIMPLE STRESES AND STRAINS : Elasticity and plasticity – Types of stresses and strains – Hooke's law – Stress-strain diagram for mild steel – Working stress – Factor of safety.

Lateral strain – Poisson's ratio and volumetric strain – Elastic moduli and relationship between elastic constants – Bars of varying section – Composite bars – Temperature stresses.

UNIT V

STRAIN ENERGY: Gradual, sudden and impact loading – Endurance limit principles of virtual work and its applications.

TEXTBOOKS:

1. Ghose D.N. – Applied Mechanics and Strength of Materials.
2. Timoshenko & Young – Engineering Mechanics.
3. Junarkar SB – Mechanics of Structures – Vol. I.
4. Junarkar SB – Elements of Applied Mechanics.

ME 105	WORKSHOP / MANUFACTURING PRACTICE	Credits: 1.5
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Laboratory Outcomes

1. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes:

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricatecomponents using different materials.

Workshop Practice: Five practices among

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical wiring
5. Welding shop
6. Casting
7. Smithy
8. Plastic moulding & Glass Cutting Examinations could involve the actual fabrication of simple components, utilizing one or More of the techniques covered above.

Detailed Contents

1. Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools.
4. Electrical &Electronics
5. Carpentry
6. Plastic moulding. Glass cutting
7. Metal casting.
8. Welding(arc welding & gas welding), brazing

The above course content is learnt by online videos/ppt presentations.

Text / Reference Books:

1. HajraChoudhury S.K., HajraChoudhury A.K.andNirjharRoy S. K., Elements of Workshop Technology", Vol. I 2008and Vol. II 2010, Media promoters and Publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid ManufacturingFngineeringand Technology", 4^{th}edition, PearsonEducationIndiaEdition,2002.

3. GowriP.Hariharanand A. SureshBabu, Manufacturing Technology–I" Pearson Education, 2008.
4. Roy A. Lindberg, processes and Materials of manufacturing", 4th edition, Prentice Hall.
5. RaoP.N., "ManufacturingTechnology",Vol. I & II,TataMcGrawHillHouse, 2017

CS 106	PROGRAMMING FOR PROBLEM SOLVING LAB	Credits: 1.5
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Objectives:

1. To provide exposure to problem-solving through programming
2. To train the student on the concepts of the C- Programming language

The following programs shall be developed and executed in Programming Language C.

1. Programs on conditional control construct.
2. Programs on iterative statements (while, do-while, for).
3. Programs on recursive procedures
4. Programs on arrays, matrices (single and multi-dimensional arrays).
5. Programs using user defined functions, demonstrating parameter passing methods viz. call by value and call by reference.
6. Programs using different library functions viz. ctype.h, math.h, stdio.h, stdlib.h, string.h, conio.h and pre-processor directives.
7. Programs using pointers (int pointers, char pointers) and pointer arrays.
8. Programs on structures and unions
9. Programs on File Processing.
10. Programs on Pointers to structures and Self-referential structures

Course Outcomes: After Completion of this course the student would be able to

1. Develop the C code for the given algorithm.
2. Understand, debug and trace the execution of programs written in C language.

Reference Books:

1. Scheldt H, C: The Complete Reference, 4th Edition, Tata McGraw-Hill, 2002.
2. Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson Education, 2019.
3. R.G. Dromey, How to solve it by Computer, Pearson Education, 2019.
4. Behrouz A. Forouzan& Richard F. Gilberg, Computer Science: A Structured Programming Approach Using C, Third Edition, Cengage Learning

CE 107	**ENVIRONMENTAL SCIENCE** *(Audit Course / No University Exam)*	**Credits: 0(Zero)**
Sessional Marks: **100**	**4L:0T:0P**	End Examination Marks: **NIL**

Course Outcomes:

At the end of the course, students will be able to

1. Acquire knowledge in
   - diverse components of environment and natural resources
   - ecosystem and biodiversity & its conservation methods
   - population growth and human health
   - green technology
2. Identify and resolve the issues related to sources of different types of pollutions
3. Provide solutions to individuals, industries and government for sustainable development of natural resources
4. Apply environmental ethics in protection of diversified ecosystems.

UNIT I

Environmental Studies and Natural Resources

Definition, Scope and importance of Environment, Environmental studies, Need for public awareness

Components of Environment- Atmosphere, Hydrosphere, Lithosphere.

Renewable and **Non-Renewable Resources and associated problems**

Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dam benefits and problems.

Forest resources: Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Land resources: Land as a resource, land degradation, Man induced landslides, soil erosion and desertification.

Mineral resources: Use and overexploitation, Environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, Case studies.

Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

Role of an individual in conservation of natural resources.

UNIT II

Ecosystem and Biodiversity

Ecosystem - Concept of an ecosystem, Structure and functions of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem.

(a) Forest ecosystem. (b) Grassland ecosystem

(c) Desert ecosystem. (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation:

Definition, genetic species and ecosystem diversity, Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts, Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – III

Environmental pollution and Global Effects

Definition, Causes, Effects, and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Pollution case studies.

Disaster management: Floods, earthquakes, cyclone, landslides, Tsunami. Climate change-Global warming, Acid rain, Ozone depletion.

UNIT – IV

Environment Issues and Management

- Environment and Human health – Epidemic diseases, HIV/AIDS, Aviation Flue, Water Borne Diseases.
- Environmental Impact Assessment, Sustainable Development, Clean Production and Clean Development Mechanisms
- Environment Legislation: Environmental Protection Act, Water Act, Air Act, Wild Life Protection Act, Forest Conservation Act, Public Liability & Insurance Act, Issues involved in Enforcement of Environmental legislation.

UNIT – V

Social Issues and the Environment

- Population growth, Population Explosion, Population Control, Women and Child welfare.
- Urbanization, Industrialization, Development projects, Resettlement and Rehabilitation of people – Problems concerned, Case studies.
- Consumerism and Waste Products Conservation, Public Awareness, Water Conservation, Rain water harvesting, watershed management, Wasteland reclamation, Human Rights, Value education, Environmental ethics- Issues and possible solution.
- Role of information Technology in Environment and Human Health.

Text Books / Reference Books :

1. Anubha Kaushik & C P Kaushik, Environmental studies, New age International Publishers, 2008
2. Benny Joseph, Environmental studies, Tata McGraw-Hill Publishers, 2005
3. M Chandra Sekhar, Environmental Science, Hi-Tech Publishers, 2004
4. Keerthinarayana and Daniel Yesudian, Principles of Environmental Sciences and

Engineering, Hi-Tech Publishers, 2005
5. AmalK.Datta, Introduction to Environmental Science and Engineering, Oxford & IBH Publishing Co.Pvt.Ltd, 2000
6. SanthoshkumarGarg,RajeshawriGarg and RajniGarg, Ecological and Environmental studies, Khanna publishers, 2006
7. Gilbert M, Introduction to Environmental Engineering and Science, Masters Publication by Prentice –Hall of India Private Ltd., 1991
8. William P Cunningham and Mary Ann Cunningham, Principles of Environmental Science, Tata McGraw Hill Publishing Co.Ltd, 2002

II – SEMESTER

MA 201	MATHEMATICS II	Credits: 4
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. Use ranks of matrices to decide whether the system of linear equations is consistent or not
2. Use Cayley-Hamilton theorem to find inverses or powers of matrices.
3. Use Eigen values and vectors to reduce Quadratic forms to normal form.
4. To analyze motion problems from real lines to curves and surfaces in 3-D and use tools such as divergence and curl of vector and gradient, directional derivatives that play significant roles in many applications.
5. Use Green's theorem to evaluate line integrals along simple closed contours on the plane
6. Use Stokes' theorem to give a physical interpretation of the curl of a vector field
7. Use the divergence theorem to give a physical interpretation of the divergence of a vector field.
8. Find the Fourier Series to represent a function as a series of constants times sine and cosine functions of different frequencies in order to observe periodic phenomenon.
9. Evaluate certain improper integrals to make them simple with introduction of Gamma and Beta functions.
10. Study certain special functions that arise in solving certain ordinary differential equations to model many physical phenomena.

Unit I

Matrices: rank of a matrix-solution of system of linear equations-Eigen values, vectors – Canley- Hamilton theorem-quadratic forms- diagonalization.

Unit II

Vector Calculus: Gradient, Divergence, Curl of a vector and related properties-line, surface, volume integrals- Green's, Stokes's and Gauss Divergence theorems and its applications.

Unit III

Fourier Series: Fourier series-even and odd functions, periodic functions-half range sine and cosine series-harmonic analysis.

Unit IV

Special Functions I: Gamma and Beta functions-series solutions of differential equations-ordinary points.

Unit V

Special Functions II: Bessel function-recurrence formulae-generating function for $J_n(X)$-Lengender polynomials-recurrence formulae-generating function for $P_n(X)$ - Rodriguez's formula - orthogonality of Lengender polynomials.

Text/Reference Books

1. B S Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2. M K Venkataraman, Engineering Mathematics, National Publishing Company, Chennai.
3. B V Ramana, Higher Engineering Mathematics, 6th Reprint, Tata McGraw-Hill, 2008.
4. Bali and Iyengar, Engineering Mathematics, 6th Edition, Laxmi Publications, 2006.

CY 202	ENGINEERING CHEMISTRY	Credits: 4
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. Analyze microscopic chemistry in terms of atomic and molecular orbital and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalize periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
5. List major chemical reactions that are used in the synthesis of molecules.

UNIT I

Atomic and molecular structure (12 lectures)

Postulates of quantum chemistry. Schrodinger equation. Particle in a box solutions, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals, Equations for atomic and molecular orbitals, Energy level diagrams of diatomics, Pi-molecular orbitals of butadiene and benzene. Band structure of solids and the role of doping on band structures

UNIT II

Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclearmagnetic resonance and magnetic resonance imaging, surface characterization techniques.

UNIT III

Chemical equilibria, Intermolecular forces and potential energy surfaces

Use of free energy in Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cellpotentials, the Nernst equation and applications.

Use of free energy considerations in metallurgy through Ellingham diagram. Equations of state of real gases and critical phenomena.

UNIT IV

Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular
geometries, Born- Haber cycle, The use of reduction potentials, Properties of ionic and covalent compounds.

UNIT V

Stereochemistry, **Organic reactions and synthesis of a drug molecule**

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings Synthesis of a commonly used drug molecule.

Reference/Textbooks

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistryby P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Ed.
7. Principles of physical chemistry, Puri, Sharma and Pattania.

EN 203	ENGLISH	Credits: 2
Sessional Marks: **40**	**2L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. learn the elements of grammar and composition of English Language.
2. Learn literary texts such as Short stories and prose passages.
3. maintain linguistic competence through training in vocabulary, sentence structures and pronunciation.
4. develop communication skills by cultivating the habit of reading comprehension passages.
5. develop the language skills like listening, speaking, reading and writing.
6. Make use of self-instructed learner friendly modes of language learning through competence.

UNIT I

Vocabulary Building

The concept of Word Formation- Root words from foreign languages and their use in English- Acquaintance with prefixes and suffixes from foreign languages in English form derivatives- Synonyms, antonyms, and standard abbreviations.

UNIT II

Basic Writing Skills

Sentence Structures – Use of phrases and clauses in sentences –Importance of proper punctuation - Creating coherence – Organizing principles of paragraphs in documents - Techniques for writing precisely

UNIT III

Identifying Common Errors in Writing

Subject-verb agreement -Noun-pronoun agreement -Misplaced modifiers -Article -Prepositions - Redundancies -Clichés

UNIT IV

Nature and Style of sensible Writing

Describing - Defining - Classifying –Providing examples or evidence –Writing introduction and conclusion

UNIT V

Writing Practices

Comprehension - Précis Writing –Essay Writing

Reference/Textbooks:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper ResourceBook. 2001
4. Study Writing. LizHamp- Lyonsand Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay KumarandPushpalata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

EE 204	ELECTRICAL CIRCUITS	Credits: 4
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will be able to

1. Gain the knowledge on Basic circuit concepts, Mesh & Nodal analysis and network topology concepts.
2. Analyze the single phase AC circuits under steady state conditions
3. Design and analyze series and parallel resonant circuits
4. Draw the Current locus diagrams
5. Analyze three phase AC circuits

UNIT I

Basic Circuit Concepts: Electrical circuit elements (R, L and C), Classification of Circuit elements, Voltage and Current sources, Source transformation Techniques– Kirchhoff's laws – Star-delta transformation – Network reduction techniques - Mesh and Nodal Analysis for D.C. Circuits– Concept of mutual inductance – Dot convention.

UNIT II

Network Topology: Graph, tree, incidence matrix, and tie set and cut set matrices – Formulation of equilibrium equations based on graph theory. Duality and dual circuits

A.C. Fundamentals: Periodic waveforms – Average and effective values of different waveforms - Form factor and crest factor.

UNIT III

A.C. Circuits: Phase and phase difference – Phasor notation – Concept of reactance, impedance, susceptance and admittance – Power factor -Active and reactive power – Impedance Triangle-Power triangle – Steady State analysis of single-phase A.C. circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel) – Phasor diagrams. Mesh and Nodal Analysis for A.C. Circuits.

UNIT IV

Resonance: Series and Parallel Resonance – Resonant frequency, Half power frequencies, bandwidth and Quality Factor.

Locus diagrams: Current locus diagrams of RL and RC series circuits and two branch parallel circuits.

UNIT V

Three Phase Circuits: Advantages of three phase systems – Phase sequence – Balanced and Unbalanced systems – Magnitude and phasor relationships between line and phase voltages and currents in balanced star and delta circuits – Analysis of balanced and unbalanced three phase circuits with star and delta connected loads, Measurement of three phase power – Two wattmeter method.

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co

ME 205	ENGINEERING GRAPHICS AND DESIGN	Credits: 3.5
Sessional Marks: **40**	**2L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, the student will be able to

1. Make a distinction between first angle projection and third angle projection of drawing
2. Draw hyperbola, parabola, Involutes and Cycloidal curves.
3. Draw sections of solids including cylinders, cones, prisms and pyramids.
4. Draw projections of lines, planes, solids and sections of solids.
5. Draw orthographic projections of lines, planes, and solids.

Question Paper
Modular – 4 questions from
Units I t0 IV, 15 marks each

Unit I

Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epi-cycloid, Hypo- cycloid and Involutes.

Unit II

Scales- Scales– construction of Plain &Diagonal Scales.

Projections of points, lines - Projections of Points and lines inclined to both planes, including traces;

Unit III

Projections of planes

Projections of planes (Regular surfaces only) inclined Planes-Auxiliary Planes

Projections of Regular Solids (Simple solids – cylinder, cone, prism & pyramid) those inclined to both the Planes-Auxiliary Views

Unit IV

Isometric Projections& Orthographic projections

Principles of Orthographic Projections-Conventions Draw simple objects, dimensioning and scale. Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Unit V

Introduction to CAD

CAD workstation and peripherals, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars Standard, Object Properties, Draw, Modify and Dimension, Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom used in CAD, Select and erase objects.;

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. &Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah,M.B.&RanaB.C.(2008),EngineeringDrawingandComputerGraphics,PearsonEducation
3. Agrawal B. & Agrawal C.M.(2012),Engineering Graphics, TMH Publication
4. Narayana, K.L. &P Kannaiah(2008),Text book on Engineering Drawing, Scitech Publishers
5. Corresponding set of) CAD Software Theory and User Manuals

EN 206	ENGLISH COMMUNICATION LAB	Credits: 1.5
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes:

The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Listening Comprehension -Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace - Interviews -Formal Presentations

Reference/Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. LizHamp– Lyons and Ben Heasly. Cambridge Univ. Press. 2006
5. Communication Skills. Sanjay Kumar and Pushpalata. Oxford Univ. Press.2011
6. Exercises in Spoken English. PartsI-III.CIEFL, Hyderabad. Oxford Univ. Press

III – SEMESTER

MA301B	MATHEMATICS –III	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. Acquire the knowledge of functions of complex variables.
2. understand power series and expansion of analytic function.
3. understand Laurent Series, poles, singular points, Residue theorem and its applications.
4. analyze the solutions of partial differential equations.
5. discuss the boundary value problems, one dimensional wave equation, heat equation and Laplace Equation.

UNIT- I

Complex analysis - I: Analytical functions - Cauchy-Riemann equations – Construction of Analytic functions- Complex integration - Cauchy's theorem - Integral formula - Evaluation of integrals.

UNIT-II

Complex analysis - II: Taylor's and Laurent's' series- Transformations- Conformal mapping - Bilinear transformations - Transformation of 1/z, z^2, sin z and cos z.

UNIT- III

Complex analysis –III: Singularities - Poles - Residues - Residue theorem – Contour integration- Evaluation of real integrals

UNIT- IV

Partial differential equations - I : Formation of differential equations - Classification - First order linear partial differential equations – Lagrange's' linear equation - Method of multipliers - first order non-linear partial differential equations - Charpits method.

UNIT- V

Partial differential equations - II: Method of separation of variables - One dimensional wave equation - Heat equation – Laplace's equation.

Text Books:

1.Grewal B S, Higher Engineering Mathematics, 40th Edition, Khanna Publications, 2007.
2.Venkataraman M K, Engineering Mathematics, Vol. I & II, National Publishing Company, 1993.
3.Venkataraman M K, Engineering Mathematics, National Publishing Company, 1995.
4.Grewal B S, Engineering Mathematics, 13th Edition, Khanna Publications.
5.Kreyszig E, Advanced Engineering Mathematics, 8th edition, Wiley, 1998.

EE302C	ELECTRO MAGNETIC FIELDS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, students will demonstrate the ability to

1. get acquainted with different coordinate systems and their transformation.
2. learn different concepts in Electrostatic fields.
3. learn different concepts in magnetic fields
4. get acquainted with time varying electric and magnetic fields.

UNIT-I

Electrostatic Fields: Review of Vector Algebra & Vector Calculus, Coulomb's law. Electric field intensity. Electric flux density and Gauss's law. Gauss's law in point form. Electrostatic potential. Potential gradient. Energy stored in electric field.

UNIT-II

Conductors and Dielectrics: Current and current density. Continuity equation. Conductors – Ohm's law, Resistance, Power dissipation, and Joule's law. Dielectrics – Dipole moment, Polarization, and bound charge densities. Boundary conditions. Capacitance.

UNIT-III

Magnetostatic fields: Force of a magnet on a current carrying wire**,** Biot-Savart law. Lorentz force law. Ampere's circuital law. Ampere's circuital law in point form. Scalar and vector Magnetic potential, Magnetic flux density.

UNIT-IV

Magnetic field in materials: Magnetic moment, Magnetization, and Bound current densities. Boundary conditions. Inductance. Energy stored in magnetic field.

UNIT-V

Maxwell's equations: Faraday's law – Motional and Transformer induced emfs, Faraday's law in point form. Displacement current. Maxwell's equations in differential and integral forms. Wave equation and its general solution for free space conditions.

Text Books:

1. Mathew N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press.
2. Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice-Hall of India Pvt. Ltd.

EE303C	NETWORK ANALYSIS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Apply Network theorems for the analysis of electrical circuits.
2. Analyze the time domain behavior of electrical circuits under transient conditions.
3. Evaluate the network functions and two-port network parameters.
4. Synthesize the one port networks using Foster and Cauer methods.

UNIT-I

Network Theorems: Superposition Theorem– Reciprocity theorem -Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem- Millman's Theorem — Tellegen's Theorem – Compensation Theorem - Application of these Theorems for D.C. circuits and sinusoidal steady state A.C. circuits.

UNIT-II

Transient Analysis: Time domain analysis of RL, RC, and RLC circuits for D.C. and sinusoidal excitations – Determination of initial conditions – Concept of time constant – Transient response of RL, RC, and RLC circuits using Laplace Transform techniques.

UNIT-III

Network Functions: One-port and Two-port networks – Driving point and transfer functions of networks – Properties of driving point and transfer functions – Concept of complex frequency, poles and zeros – Time domain response from pole-zero diagram – Restrictions on pole-zero locations.

UNIT-IV

Two-port Network Parameters: Open circuit impedance and short circuit admittance parameters – Hybrid and inverse-hybrid parameters – Transmission and inverse transmission parameters – Inter relationships between parameter sets – Series, Parallel, and Cascade connection of two-port networks – Conditions for reciprocity and symmetry of two-port networks. Terminated two-port networks – Image parameters.

UNIT-V

Elementary Ideas of Network Synthesis: Positive real functions - Hurwitz polynomials - Properties and realization of RL, RC, and LC immittance functions by Foster and Cauer methods.

Text Books:

1. Sudhakar and Shyammohan, Circuits and Networks: Analysis and Synthesis, 5th Edition, Tata McGraw-Hill
2. Ravish R. Singh, Network Analysis and Synthesis, Tata Mc. Graw Hill.
3. Abhijit Chakrabarti: Circuit Theory Analysis and Synthesis, 7th Revised Edition, Dhanpat Rai & Co
4. M. E. Van Valkenburg; “Network analysis”; Pearson Education, Third Revised Edition.

EE304C	D.C. MACHINES AND TRANSFORMERS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks:**60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of energy conversion principles, constructional details and principle of operation of DC machines and Transformers.
2. Analyze the performance of the DC Machines under various operating conditions using their various characteristics and testing methods.
3. Analyze the parallel operation of DC machines and transformers and select appropriate machine as per applications.
4. Evaluate the performance of Transformers using phasor diagrams, connections, testing methods and equivalent circuits

UNIT-I

Principles of electromechanical energy conversion: Energy in magnetic system, field energy and mechanical force, single and multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems.

UNIT-II

DC Generators: Construction, armature windings and its types, Emf equation, armature reaction, compensating windings, commutation, characteristics and types of generators.
Parallel operation of DC Generators: DC shunt and series generators in parallel, equalizing connections

UNIT-III

DC Motors: Force on conductor carrying current, Torque and power equations, speed control, starting and characteristics of dc motors, Losses and efficiency, testing and applications of DC machines.

UNIT-IV

Transformers: Principle, construction and operation, equivalent circuit, phasor diagrams, voltage regulation, losses and efficiency, all day efficiency, Testing of transformers**.**
Autotransformer: Construction, principle, applications and comparison with two winding transformers.

UNIT-V

Three-phase transformer: Construction, Cooling, types of connection and their comparative features, Phase conversions - Scott connection, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Parallel operation of transformers.

Text Books:

1. I.J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

References Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. B. L Theraja, A. K. Theraja, "A text book of Electrical Technology, Vol. II,
4. AC and DC Machines" S. Chand Publication, Multicolor edition, Reprint 2004

EE305C	ANALOG ELECTRONICS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. understand the characteristics of various components.
2. Understand the biasing techniques
3. Design and analyze various rectifiers, small signal amplifier circuits.
4. Design sinusoidal and non-sinusoidal oscillators.
5. Understand the functioning of OP-AMP and design OP-AMP based circuits.

UNIT-I

DIODE CIRCUITS: P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, clamping and clipping circuits. Input output characteristics of BJT in CB, CE, CC configurations, biasing circuits, Load line analysis, common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits,

UNIT-II

MOSFET CIRCUITS: MOSFET structure and I-V characteristics. MOSFET as a switch. small signal equivalent circuits - gain, input and output impedances, small-signal model and common-source, common-gate and common-drain amplifiers, trans conductance, high frequency equivalent circuit.

UNIT-III

MULTI-STAGE AND POWER AMPLIFIERS: Direct coupled and RC Coupled multi-stage amplifiers; Differential Amplifiers, Power amplifiers - Class A, Class B, Class C.

UNIT-IV

FEEDBACK AMPLIFIERS: Concepts of feedback – Classification of feedback amplifiers – General characteristics of Negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Simple problems.

OSCILLATORS: Condition for Oscillations, RC type Oscillators-RC phase shift and Wien-bridge Oscillators, LC type Oscillators –Generalized analysis of LC Oscillators, Hartley and Colpitts Oscillators.

UNIT-V

OPERATIONAL AMPLIFIERS: Ideal op-amp, Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product, Inverting and non-inverting amplifier, Differentiator, integrator, Square-wave and triangular wave generators.

Text Books:

1. Integrated Electronics, Jacob Millman, Christos C Halkias, McGraw Hill Education, 2nd edition 2010
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 2003.

References:

1. Electronic Devices Conventional and current version -Thomas L. Floyd 2015, pearson.
2. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
3. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
4. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

EE306L	ELECTRICAL CIRCUITS AND NETWORKS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Verify Network theorems for the analysis of electrical circuits.
2. Analyze the time domain behavior of electrical circuits under transient conditions.
3. Draw the locus diagrams and analyze the resonance conditions.
4. Evaluate the two-port network parameters.

Experiments related to the course contents of two courses

(1) Electrical Circuits

(2) Network Analysis.

EE307L	**D.C. MACHINES AND TRANSFORMERS LAB**	**1.5 Credits**
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**
Course Outcomes: At the end of this course, students will demonstrate the ability to 1. Test the performance of any DC machines and single-phase transformers, by conducting suitable experiments and report the results. 2. Analyze the various speed control methods of DC motors and characteristics of DC machines. 3. Understand the significance of different connections of three-phase transformers.		
Experiments related to the course contents of the course D.C. Machines and Transformers.		

EE309S	COMPUTER SKILLS	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Identify basic terms, concepts, and functions of computer system components.
2. Select and use the appropriate software application to complete a particular task such as a word Processing skill to create, save, modify business documents.
3. Identify basic concepts and procedures for creating, viewing, and managing files, and folders for different operating systems.
4. Identify basic concepts of organization and procedures for creating, and viewing will software presentation such as PowerPoint.

Experiments related to the following topics:

- Installations of Computer Software.
- Word Processing using MS Office.
- Documentation using LaTex.
- Mathematical Calculations using Spreadsheet.
- Presentation using Power Point.
- Brief study of internet and types of networks.
- Brief Study of world wide web and web browsers.
- Brief Study of Electronic Mail management system.
- Preparation of various data collection forms.

MC310A	**CONSTITUTION OF INDIA** *(Audit Course / No University Exam)*	**0 Credits**
Sessional Marks: **100**	**2L:0T:0P**	End Examination Marks: **NIL**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I

History of Making of the Indian Constitution: History. Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution: Preamble Salient Features

UNIT-II

- **Contours of Constitutional Rights & Duties:**
- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT-III

- **Organs of Governance:**
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor

- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT-IV

- **Local Administration:**
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-V

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

IV - SEMESTER

EE401C	POWER SYSTEMS-I	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will be able to

1. Understand the power system structure and principles of energy generation from conventional and renewable energy sources
2. Analyze the economic aspects of power generation.
3. Acquire the knowledge on parameter calculations and mechanical design in transmission lines.

UNIT-I

Fundamentals of Power systems: Evolution of Power Systems- Present Day Scenario-Structure of a power system-Conventional and Renewable Energy Sources.

Power Stations: Hydro-electric, Thermal Stations, Gas Turbine and Nuclear power Stations-Selection of site, Main parts, lay out and working principle.

UNIT-II

Renewable Energy sources: Necessity- principle of operation and working of Solar electric system, wind electric system, bio-mass and bio-gas plants, Fuel cells, Tidal and Geothermal power plants - applications.

UNIT–III

Economic aspects of power stations: Types of loads-Load curve, load duration and integrated load duration curves-Load factor-Demand factor-Diversity factor-Capacity factor-Utilization and plant use factors-The effect of these factors on generation-Number and size of generating units-Base load and peak load plants-Costs of electrical energy-Types of tariff charges on consumers.

UNIT-IV

Inductance and capacitance calculations of transmission lines: Line Conductors-Resistance-Inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacings-Composite conductors-transposition-Bundled Conductors-Effect of earth on capacitance.

UNIT-V

Mechanical design of Transmission line: Catenary Curve-Sag tension calculations- Supports at equal and different levels, effect of wind and ice loading – stringing chart – sag template – conductor vibrations.

Corona: Introduction- critical disruptive voltages-Corona loss-factors affecting corona loss-Methods of reducing corona loss-Disadvantages of corona-Inductive interference between power and communication lines.

Text Books:

1. C..L.Wadhwa, "Generation Distribution and utilization of Electrical energy" , New Age International
2. Power plant Engineering by A.K.Raja etc, New age International Publishers.
3. G. D. Rai, 'Non-Conventional Energy Sources', Khanna Publishers, New Delhi, 2006.
4. C..L.Wadhawa, "Electrical Power systems" New age publications.
5. B.R.Gupta, "Power system analysis and design" third edition, Wheeler publishing.
6. William D.Stevenson "Elements of power system analysis" fourth edition, Mc Grawhill International editions.
7. AR Bergen and Vijay Vittal, "Power system analysis", Pearson education, 2001

EE402C	INDUCTION MOTORS AND SYNCHRONOUS MACHINES	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Course Outcomes: Upon completion of this course, students will be able to

1. Understand the constructional details and principle of operation of Induction and Synchronous Machines.
2. Understand parallel operation, speed control and starting of AC machines.
3. Analyze the performance of the Induction and Synchronous Machines using the phasor diagrams, equivalent circuits and by testing.
4. Select appropriate AC machine for any application and appraise its significance.

UNIT-I

Three phase Induction Motors: Construction and principle of operation, types, torque equations, torque slip characteristics, phasor diagrams, equivalent circuit, circle diagram, testing and starting methods.

UNIT-II

Speed control of Three-phase Induction Motors: Pole changing, Cascade connection, injection of emf in to rotor circuit, V/f control of 3-phase induction motor, Double cage induction motor, induction generator and its applications.

Single-phase Induction Motors: Construction, principle, double revolving field theory, equivalent circuit, applications, starting methods, Universal motor

UNIT-III

Synchronous Generators: Construction, principle, emf equation, Armature reaction, leakage flux, synchronous reactance, equivalent circuit, Phasor diagram, voltage regulation, determination of regulation by synchronous impedance method, mmf method, ZPF method, ASA method.

UNIT-IV

Theory of Synchronous Machines: Phasor diagram, determination of X_d and X_q from Slip test, Expression for power expressions, power angle characteristics.

Parallel Operation of Synchronous Generators: Conditions, Synchronizing, load sharing, operation of alternator with infinite busbars, effect of change of mechanical input and excitation, Excitation systems, transient and sub- transient reactance.

UNIT-V

Synchronous Motors: Principle of operation, methods of starting, Phasor diagram, variation of current and power factor with excitation, Predetermination of V and inverted V curves, Hunting and use of damper bars, Synchronous condenser and power factor correction, Excitation and power circles.

Text Books:

1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.

2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.

3. M. G. Say, 'Performance and Design of Alternating Current Machines', CBS Publishers & Distributors Pvt. Ltd., New Delhi, 3rd Edition, 2002

Reference Books:

1. A.E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
3. P. C. Sen., "Principles of Electric Machines and Power Electronics", 2nd edition, John Wiley and Sons Inc., 1997.

HS403C	MANAGERIAL ECONOMICS AND ACCOUNTANCY	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand Macro Economic environment of the business and its impact on enterprise.
2. Identify various cost elements of the product and its effect on decision making.
3. Understand the concepts of financial management and smart investment.
4. Prepare the Accounting records and interpret the data for Managerial Decisions.

UNIT -I

Introduction to Engineering Economics, Fundamental concepts, Time value of money, Cash flow and Time Diagrams, choosing between alternative investment proposals, Methods of Economic analysis (pay back, ARR, NPV, IRR and B/C ratio), The effect of borrowing on investment, Equity vs Debt Financing, concept of leverage, Income tax leverage.

UNIT -II

Depreciation and methods of calculating depreciation (straight line, sum of the years digit method, Declining balance method, Annuity method, Sinking fund method), National income accounting Methods of estimation, Various concepts of National Income, Significance of National income Estimation and its limitations.

UNIT -III

Inflation: Definition, Process and Theories of inflation and Measure of control. New Economic Policy 1991(Industrial Policy, Trade Policy, Fiscal Policy), Impact on Industry.

UNIT -IV

Accounting Principles, procedure, Double entry system, Journal, ledger, Trial balance, Cashbook, preparation of Trading and Profit and Loss account, Balance sheet.

UNIT -V

Cost Accounting**:** Introduction, Classification of costs, Methods of costing, Techniques of costing, Cost sheet and preparation of cost sheet, Break-even Analysis, Meaning and its application, Limitation.

Text Books:

1. Henry Malcom Steiner, Engineering Economics Principles, 2nd Edition, McGraw Hill Education, 1996.
2. Dewett. K.K., Modern Economic Theory, Sultan Chand and Co., 2006.
3. A.N. Agarwal, Indian Economy, Wiley Eastern Limited, New Delhi.
4. Jain and Narang, Accounting Part-I, Kalyani Publishers, 2011.
5. Arora, M.N. Cost Accounting: Principles and Practice, 12th Edition, Vikas Publication, 2012.

EE404C	DIGITAL ELECTRONICS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand working of logic families and logic gates.
2. Design and implement Combinational and Sequential logic circuits.
3. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
4. Be able to use PLDs to implement the given logical problem.

UNIT-I

Fundamentals of Digital Systems and logic families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT-II

Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT-III

Sequential circuits and systems: A 1-bit memory, the circuit properties of Bi stable latch, the clocked SR flip flop, J- K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

UNIT-IV

A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, duals lope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

UNIT-V

Semiconductor memories and Programmable logic devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

EE405C	SIGNALS AND SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Differentiate between various types of signals and understand the implication of operations of signals
2. Understand and classify systems based on the impulse response behaviour of both continuous-time and discrete-time systems
3. Perform domain transformation from time to frequency and understand the energy distribution as a function of frequency
4. Usefulness of convolution for analysing the LTI systems and understand the concepts of power spectral density through correlation.
5. Solve differential and difference equations with initial conditions using Laplace and Z-transforms.

UNIT-I

Introduction to Signals and Systems: Definition and classification of signals and systems**,** Basic operations on signals, Elementary signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time-Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral. Causal LTI Systems Described by Differential and Difference Equations.

Signal Analysis: Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions.

UNIT-II

Fourier series and Fourier Transform: Fourier series Representation of Continuous-Time Periodic Signals, Dirichlet's conditions, Properties of Continuous-Time Fourier Series. Trigonometric Fourier Series and Exponential Fourier Series with examples, Complex Fourier spectrum.

Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Continuous-Time Fourier Transform,

Magnitude-Phase responses, Parseval's theorem, Inverse Fourier transform.

Discrete-Time Fourier Transform – Properties, Inverse Discrete-time Fourier Transform. Introduction to Hilbert Transform.

UNIT-III

Convolution and Correlation: Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Properties, Energy spectral density, Power spectral density, Relation between convolution and correlation.

UNIT-IV

Behavior of continuous time LTI systems: Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

Sampling: Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation,

types of sampling-natural sampling, flat- top sampling and impulse sampling, Effect of under sampling -Aliasing.

UNIT-V

System Analysis using Laplace and z -Transforms:

Laplace Transform - Region of Convergence – Relation between Laplace and Fourier Transform, Inverse Laplace Transform, Properties, Analysis and Characterization of LTI Systems Using Laplace Transform, Z-Transform -Region of Convergence - Properties, Inverse z-Transform, Analysis and Characterization of LTI Systems Using z-Transforms.

Text Books:

1. Anand Kumar, Signals & Systems, PHI, 2011.
2. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid Nawab, "Signals and Systems," Pearson Higher Education, 2nd Ed., 1997.
3. Simon Haykin and B. Van Veen, "Signals & Systems," John Wiley and Sons, 2nd Edition, 2007.

Reference Books:

1. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
2. B.P. Lathi, "Principles of LINEAR SYSTEMS and SIGNALS," Oxford Univ. Press, Second Edition, International version, 2009.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. Luis F. Chaparro, "Signals and Systems using MATLAB," Academic Press, 2011.
5. C. L. Philips, J. M. Parr and Eve A. Riskin, "Signals, Systems and Transforms," Pearson Education, 4th Edition, 2008.

EE406L	**INDUCTION MOTORS AND SYNCHRONOUS MACHINES LAB**	**1.5 Credits**
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Test the performance of induction motors and synchronous machines by conducting suitable experiments and report the results.
2. Analyze the speed control methods of three-phase induction motors by conducting suitable experiments.
3. Understand the parallel operation and estimate the regulation of alternators.

Experiments related to the course contents of the course - Induction & Synchronous Machines.

EE407L	**ANALOG AND DIGITAL ELECTRONICS LAB**	**1.5 Credits**
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Plot the characteristics of Electronic Devices to understand the behavior
2. Design, construct and test amplifier circuits and interpret results
3. Design and analyze combinational logic circuits
4. Design and analyze flip flops and Sequential logic circuits

Experiments related to the course contents of two courses

(1) Analog Electronics

(2) Digital Electronics.

EE409S	**PYTHON PROGRAMMING**	**2 Credits**
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Implement python programming constructs to build small to large applications.
2. Implement the problems in terms of real-world objects.
3. Evaluate and handle the errors during runtime involved in a program.
4. Extract and import packages for developing different solutions for real time problems

Experiments related to the Python Programming Course:

- Python Programming Fundamentals
- Python Built-in Data Structures
- Classes & Objects
- Functions, I/O, Exception Handling in Python
- Applications

V – SEMESTER

EE501C	POWER SYSTEMS-II	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: Power systems-1, Network Analysis

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Analyze the performance of different transmission lines and different voltage control methods
2. Understand the concepts of substations and overhead line insulators
3. Study and Evaluate power system transients
4. Understand the concepts of Underground Cables
5. Analyze and understand the concepts of Distribution systems

UNIT-I

Performance of transmission lines: Representation of lines - short transmission lines - medium transmission lines - Nominal pie and T representation of long lines by distributed parameters - Equivalent T and Pie representation of long transmission lines - Evaluation of ABCD parameters of long lines - Ferranti effect.

Voltage Control using Shunt and series capacitors - synchronous capacitors - Tap changing andBooster Transformers - Surge Impedance Loading (SIL).

UNIT-II

Substations: Number and size - Location and installation - The main equipment in substations - Bus Arrangements - Key diagram of a typical primary substation.

Overhead line insulators: Introduction - Types of insulators - Potential distribution over a string of insulators - Methods of equalizing the potential, string efficiency - Testing of insulators.

UNIT–III

Power system transients: Introduction - Circuit closing transients - Sudden symmetrical short circuit analysis of alternator - Recovery transient due to removal of a short circuit - Travelling waveson transmission line - Surge impedance and wave velocity - Specification of travelling waves - Reflections and refractions of waves - Different types of terminations - Forked line - Successive reflections - Bewley's Lattice Diagram - Attenuation and Distortion - Arcing grounds.

UNIT-IV

Underground Cables: Introduction - The insulation types - Insulating materials for EHV voltage cables - Classification of cables - Parameters of single core cable - Grading of cables -Capacitance of three core belted cable break down of cables - Heating of cables – dielectric loss and Sheath losses - Current rating of cables

UNIT-V

AC Distribution: Comparison of AC single phase, 3 phase 3 wire and 3 phase 4 wire systems with DC 2 wire - Types of primary distribution systems - Types of secondary Distribution systems - AC distributors fed at one end and at both ends-Kelvin's law - Limitations of Kelvin's law - Load estimation - Selection voltage of primary distribution - Choice of scheme - Size of feeders, power factor correcting methods

Text Books:

1. C..L.Wadhwa, "Electrical Power systems" New age publications.
2. B.R.Gupta, "Power system analysis and design" third edition, Wheeler publishing.
3. William D.Stevenson "Elements of power system analysis" fourth edition, Mc Grawhill International editions.

Reference Books

1. C.L.Wadhwa, "Generation Distribution and utilization of Electrical energy" , New Age International
2. AR Bergen and Vijay Vittal, "Power system analysis", Pearson education, 2001

EE502C	LINEAR CONTROL SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: Engineering Mathematics, Network Analysis

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function andstate-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Understand the applications of control systems in industries.

UNIT–I

Introduction: System representation – Classification of systems – Control system technologies –Types of control Systems: open loop and closed loop systems - Advantages and disadvantages of control systems – Examples of open loop and closed loop control systems – Transfer function andlimitations

UNIT-II

Mathematical modeling of physical systems : Mathematical modeling and transfer functions ofelectrical, mechanical and electro-mechanical systems – Electrical analogues – Block diagram andtheir reduction techniques – Signal flow graphs – Introduction to servo motors – DC Servo motors
– two-phase AC servo motors.

UNIT-III

Time domain analysis: Standard test input signals – step response of first and second order systems – Time domain specifications – steady state error – static error and generalized error coefficients – Problems.

UNIT-IV

Stability of control systems: Introduction – Bounded Input –Bounded Output (BIBO) – Necessary conditions for stability – Characteristic equation and location of roots in s-plane for stability – Routh-Hurwitz criterion – Root locus techniques – Rules for construction of root loci.

UNIT-V

Frequency domain analysis: Introduction to frequency domain specifications – correlation between time domain and frequency domain responses – Frequency response plots – polar plots –Nyquist Plots – Relative stability using Nyquist criterion – Bode plots – Gain margin and Phase margin.

Text Books:

1. I.J. Nagrath and M. Gopal, "Control system Engineering", Wiley Eastern Ltd.
2. Benjamin C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. Ch. Chengaiah and G.V Marutheswar, "Control Systems A comprehensive Lab Manual", B.S Publications, 2017.

EE503C	POWER ELECTRONICS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre Requisites: Analog Electronics

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the differences between signal level and power level devices.
2. Analyze controlled rectifier circuits.
3. Analyze the operation of DC-DC choppers.
4. Analyze the operation of Inverters and Cyclo-Converters.

UNIT-I

Silicon controlled Rectifier – Static characteristics and ratings – turn-ON and turn-OFF mechanism – Gate characteristics – Series and parallel operation of SCR's static and dynamic equalization circuits – Protection circuits – Design of snubber circuit – Class A,B,C,D,E types ofcommutation circuits.

UNIT-II

Phase controlled Rectifiers - Principles of phase control – Half-wave and full- wave controlled rectifiers with resistive, inductive and RLC load – Freewheeling diode operation – Bridge rectifiers – Single phase and three phase Rectifiers with inductive load – Half and fully controlled rectifiers – freewheeling diode operation – Effect of source inductance – Dual converter – circulation and non-circulating current mode of operation.

UNIT-III

Choppers – D.C.Choppers – Principles of operation – control strategies, constant and variable frequency system, current limit control – Types of chopper circuits – Type-A, Type B and TypeE chopper circuits Morgan chopper Jone's chopper

UNIT-IV

Inverters – Classification – series and parallel inverters improved series inverters – Bridge inverters – Commutation circuits – current and voltage commutation circuits – single phase andthree phase inverters – output waveform control – Mc Murray Inverter – Introduction to PWM techniques

UNIT-V

Cyclo-converters – Principle of operation – single phase step-up and step down cycloconverters – Three-phase half-wave cycloconverters – output voltage equation – circulation and non-circulating current mode of operation – Load commutated cycloconverter.

Speed control – Speed control of DC motors using controlled rectifiers and choppers – Speedcontrol of induction motors using inverters

Text Books:

1. An introduction to Thyristors and their application – Dr. M. Ramamoorthy – East West press.
2. Power Electronics - Dr. P.S. Bimbhra 2nd edition – Khanna publishers.
3. Power Electronics – M.D. SINGH and K.B. KHANCHANDANI – Tata Mc.Graw Hill publishers.
4. Industrial and Power Electronics – RASHID (3rd Edition)

EE504C.i	WIND AND SOLAR ENERGY SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: Power systems-I, Induction Motors and Synchronous Machines

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the solar radiation, measurements, characteristics of solar PV cell and wind turbines.
2. Develop the models of PV system and wind turbine, and their applications.
3. Analyze the electrical characteristics and operation of various wind-driven electrical generators.
4. Understand various power electronic converters used for hybrid system

UNIT-I

Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation- pyranometer – solar energy statics- Solar PV cell – I-V characteristics –P-V characteristics– fill factor-Modeling of solar cell– maximum power point tracking.

UNIT-II

PV module – blocking diode and bypass diodes– composite characteristics of PV module – PV array– PV system –PV-powered fan–PV fan with battery backup–PV-powered pumping system –PV powered lighting systems–grid- connected PV systems.

UNIT-III

Wind source–wind statistics-energy in the wind –turbine power characteristics - aerodynamics – rotor types – parts of wind turbines– braking systems–tower- control and monitoring system.

UNIT-IV

General characteristics of induction generators– grid-connected and self-excited systems– steady- state equivalent circuit-performance predetermination–permanent magnet alternators–steady- stateperformance.

UNIT-V

Power electronic converters for interfacing wind electric generators – power quality issues-hybrid systems-wind-diesel systems – wind-solar systems.

Text Books:

1. S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1stEdition, 2005.
2. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies andApplications' PHILearning Publications, 2nd Edition, 2011.

Reference Books:

1. Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and FrancisGroup Publications, 2nd Edition, 2003.
2. M. Godoy Simoes and Felix A. Farret, 'Alternative Energy Systems: Design and Analysis withInduction Generators', CRC Press, 2nd Edition, 2008
3. Ion Boldea, 'The Electric Generators Handbook- Variable Speed Generators', CRC Press, 2010.
4. Bin Wu, Yongqiang Lang, Navid Zargari, Samir Kouro, 'Power Conversion and Control ofWind Energy Systems', IEEE Press Series on Power Engineering, John Wiley & Sons,2011.
5. S. Sumathi,L. Ashok Kumar,P. Surekha ,'Solar PV and Wind Energy ConversionSystems', Springer 2015

EE504C.ii	ELECTRICAL DISTRIBUTION SYSTEM	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: Power systems-1

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basics of Distribution systems
2. Understand different Distribution Transformers &feeders
3. Understand the basics of Substations
4. Understand the working of Protective devices and coordination
5. Acquire the knowledge of power factor and voltage control

UNIT-I

Introduction to distribution systems: An overview of the role of computers in distribution system planning. Load modeling and characteristics. Coincidence factor, contribution factor and loss factor. Classification of loads (Residential, Commercial, Agricultural and Industrial) and theircharacteristics.

UNIT-II

Distribution Transformers &feeders – Distribution transformer types, regulation and efficiency.Design considerations of distribution feeders – Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

UNIT-III

Substations – Introduction – types of substations - main equipments in substations - Busbar Arrangements- Key diagram of a typical primary substation - Rating of a distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT-IV

Protective devices and coordination – Objectives of distribution system protection, Types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of fuses, circuit reclosures, line Sectionalizers, and circuit breakers. Coordination of protective devices General coordination procedure.

UNIT-V

Power factor improvement and voltage control – Capacitive compensation for power-factor control – Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and Switched), power factor correction, capacitor allocation.

Voltage control – Equipment for voltage control, effect of series capacitors, effect of AVB/AVR,line drop compensation.

Text Books:

1. "Electric power Distribution system Engineering "– by Turan Gonen, Mc Graw-Hillbook company.
2. V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw Hill PublishingCompany, 2nd edition, 2010.
3. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4thedition, 1997.

EE504C.iii	ELECTRICAL SAFETY	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre Requisites: Power Systems-1

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the need of electrical safety in different locations
2. Understand the need of electrical safety during installation of equipment's
3. Describe the electrical safety in residential, commercial and agricultural installations.
4. Explain the necessity of electrical safety in Hazardous zones
5. Understand electrical safety in distributed systems and usage of Fire extinguishers

UNIT-I

INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and itseffects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

UNIT-II

SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT: Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT-III

ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances

UNIT-IV

ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements –Specifications of electrical plants, equipments for hazardous locations – Classification ofequipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT-V

ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM: Total quality control and management – Importance of high load factor – Disadvantages of low power factor – Causes of low P.F. – power factor improvement – equipment – Importance of P.F. improvement

Fire Extinguishers: Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO2 and Halogen gas schemes; foam schemes.

Text Books:

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", ConceptPublishing Company, 1997.

Reference Books:

1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
2. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
4. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.

EE506L	CONTROL SYSTEMS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Pre-requisites: Control Systems

Course Outcomes: At the end of the course, the student will be able to:

1. Simulate the physical control system for stability studies
2. Demonstrate feedback controllers
3. Develop logic gates using PLC

LIST OF EXPERIMENTS

1. Modeling of Physical Systems (Mechanical and Electrical systems).
2. Block Diagram Reduction of Linear Systems
3. Time response analysis of Linear Systems for impulse and step inputs
4. Frequency response analysis of Linear Systems
5. Stability and relative stability analysis of Linear Systems Using (Root Locus, Bode and Nyquist plot).
6. Time Response analysis of Second Order System.
7. Study the effect of P, PD, PI, PID controllers on second order systems.
8. Magnitude and phase plot of Lag and lead compensators.
9. Determination of transfer function and effect of feedback on DC servo motor.
10. Study of logic gates using PLC

Additional Experiments

1. Design of Lag and Lead Compensators for a given system
2. Stepper motor control using Simulation tools.
3. Study the effect of P, PD, PI, PID controllers on DC servomotor system using PLC.

EE507L	POWER ELECTRONICS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Pre-requisites: Power electronics Theory

Course Outcomes: At the end of the course, the student will be able to :

1. Examine the characteristics of Power electronic devices
2. Analyze the performance of different power converters using trainer kits.
3. Evaluate the performance of different power converters using simulation tools

LIST OF EXPERIMENTS

1. Study the operation of a matrix converter.
2. Obtain the static V-I characteristics of SCR and IGBT.
3. Connect 1-Φ fully controlled rectifier and to control the speed of a DC motor.
4. Observe the output waveform of series inverter.
5. Verify the operation of dual converter.
6. Observe the output waveforms of 1-Φ parallel inverter at different frequencies.
7. Study the speed control of 3-Φ induction motor in open- loop and closed loop using sinusoidal PWM techniques.
8. Study the circuit of 3-Φ half controlled rectifier.
9. Verify Jone's chopper.

EE508S	MATLAB Laboratory	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Pre-requisites: Computer Skills

Course Outcomes: At the end of the course, the student will be able to :

1. Learn the MATLAB environment and its programming fundamentals
2. Write programs using commands and functions
3. Handle and solve problems using MATLAB and to draw the plots
4. Create Simulink model

LIST OF EXPERIMENTS

1. To write a program for matrix operation and various functions.
2. To develop a program for finding solutions of linear equations and factorial of a number.
3. To develop a program for geometric progression and convolution of two signals.
4. To write a program to draw a circle and different type of plots.
5. To write a program for different types of waveforms with and without switch case.
6. To develop a program for integral and differentiation of a polynomial.
7. To develop a program to find largest & smallest and ascending & descending order by using MATLAB software.
8. To write a program to find date & calendar, given input year is leap year or not
9. To develop a program for displaying multiplication table and factorial of a given number.
10. To write a program code for taking students and employee details

MC509A	UNIVERSAL HUMAN VALUES *(Audit Course / No University Exam)*	0 Credits
Sessional Marks: **100**	**2L:0T:0P**	End Examination Marks: **NIL**

Pre-requisites/co-requisites: None.

COURSE OUTCOMES: At the end of this of this course, the students will be able

1. To become more aware of themselves, and their surroundings (family, society, nature)
2. To distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. To Understand the role of a human being in ensuring harmony in society and nature.
4. To become sensitive to their commitment towards what they have understood (human values, human relationship and human society)
5. To Distinguish between ethical and unethical practices, and start working out thestrategy to actualize a harmonious environment wherever they work.

UNIT I

Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of everyhuman being with their correct priority. Understanding Happiness and Prosperity correctly - Acritical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II

Understanding Harmony in The Human Being - Harmony in Myself: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility (Sukh and Suvidha). Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaningofProsperity in detail. Programs to ensure Sanyam and Health.

UNIT III

Understanding Harmony in The Family and Society- Harmony in Human- Human Relationship: Understanding harmony in the Family - the basic unit of human interaction. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual

happiness (Ubhay-tripti); Trust **(Vishwas)** and Respect **(Samman)** as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence.

Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution (Samadhan), Prosperity (Samridhi), fearlessness (**Abhay**) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) - fromfamily to world family.

UNIT IV

Understanding Harmony in The Nature and Existence - Whole Existence as Coexistence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT V

Implications of The Above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basisfor Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competencein professional ethics: a. Ability to utilize the professional competence for augmenting universalhuman order b. Ability to identify the scope and characteristics of people friendly and eco- friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.

TEXT BOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks,New Delhi, 2010.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

REFERENCE BOOKS:

1. E. F. Schumancher, 1973, Small is Beautiful: a study of economics as if people mattered.Blond & Briggs, Britain.
2. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
3. Ivan IIlich, 1974, Energy & Equity, The Trinity Press, Worcester, and

HarperCollins, USA
4. A Nagraj, 1998 Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
5. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986, 1991.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi TantraShodh, Amravati.
7. E G Seebauer & Robert L.Berry, 2000, Fundamentals of Ethics for Scientists &Engineers,Oxford University Press.
8. M Govindrajan, S Natrajan & V. S Senthil kumar, Engineering Ethics (including Humna Values), Eastern Economy Edition, Prentice Hall of India Ltd.
9. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
10. India Wins Freedom - Maulana Abdul Kalam Azad.

Relevant CDs, Movies, Documentaries & Other Literature:

1. value Education website, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. AI Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charle Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology - the Untold Story.

VI - SEMESTER

EE601C	POWER SYSTEM ANALYSIS	4 Credits
Sessional Marks: **40**	**3L:1T:0P**	End Examination Marks: **60**

Pre-Requisites: Power systems-2

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Analyze symmetrical and unsymmetrical faults.
2. Apply the load flow techniques and carry out load flow study of power systems.
3. Study and analyze the transient and steady state stability of power systems

UNIT-I

Fault studies: Per unit system, Introduction to symmetrical fault analysis-short circuit capacity ofa bus-The short circuit currents and the reactance of synchronous machines-Internal voltages of loaded machines under transient conditions-Expressions for fault MVA in terms of per unit and percentage quantities-Need for current limiting reactors and their location-selection of circuit breakers.

UNIT-II

Sequence Networks: Symmetrical Components-phase shift of symmetrical components in Star- Delta transformer banks -Power in terms of symmetrical components - Sequence impedances and sequence networks-Sequence impedances of generators-Sequence impedances of transmission lines-Sequence impedances of transformers.

Unsymmetrical fault Analysis: Fault current calculations for single line to Ground fault, Line toLine fault and Double line to Ground fault, open conductor faults.

UNIT-III

Load flow studies: Need for load flow studies in a power system-Formation of Bus admittance matrix-Classification of types of buses in a power system-Formulation of load flow equations- Gauss-Seidel, iterative method for load flow studies-Treatment of PV bus-Acceleration factors- Newton Raphson method for load flow solution with rectangular and polar coordinates- formulation of load flow equations-Decoupled and fast decoupled load flow.

UNIT-IV

Stability studies: Classification of stability studies-The power flow equations of round rotor andsalient pole synchronous machine connected to infinite bus through a transmission system under steady state and transient state - Power flow equations of a two-machine system - Power flow equations in terms of ABCD constants-Power angle diagrams-Derivation of swing equation, Inertia constant. steady state stability analysis: Steady state stability and steady state stability limits.

UNIT-V

Transient stability analysis: General considerations and assumptions-Transient stability and stability limits-Reduction of two finite machine system to one machine system-Solution of swing equation of one machine system by point-by-point method-Digital solution by numerical methods- Equal area criterion-Limitations of equal area criterion- Determination of critical clearing angle. methods for improving power system stability.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw HillEducation,1994.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill Education, 2nd Edition,2002.

Reference books:

1. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
2. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
3. Power System Analysis and design by B.R.Gupta, S.Chand publications.

EE602C	ELECTRICAL AND ELECTRONICS MEASUREMENTS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre Requisites: Electrical Circuits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the working principle of different measuring instruments.
2. Select appropriate measuring instruments for measuring various parameters in theirlaboratory courses.
3. Study and correlate the significance of different measuring instruments, recorders andoscilloscopes.

UNIT–I

Measurements – Errors & classification, Deflecting, control, and damping torques in instruments Measurement of voltage & current - permanent magnet moving coil and moving iron meters, dynamometer type instruments.

UNIT–II

Measurement of potential difference, current, and resistance – DC bridges, A.C & DC potentiometers.

Measurement of inductance, capacitance, and resistance- AC bridges.

UNIT–III

Instrument transformers – Current and Potential Transformers, Ratio and phase angle errors.

Measurement of power – Electrodynamic instruments, Induction instruments.

Measurement of energy – Single phase and three phase energy meters.

UNIT–IV

Power factor meters**,** Synchronoscopes, Ratiometers, Frequency meters, Q-meters, Digital Voltmeters, Multimeters.

UNIT – V

Transducers – Position transducers, Force transducers, Piezo-electric transducers, Hall effecttransducers. Temperature measurement.

Signal sources – Oscillators, Function generator & pulse generators.

Oscilloscopes - CRO, Digital storage and Analog storage Oscilloscope. Analog & DigitalRecorders, error analysis.

Text Books:

1. A. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai & Co., 9 th Edition, 2015.
2. W. D. Cooper," Electronic Instrumentation and Measurement Techniques",

Prentice Hallof India Publications, 1st Edition, 2009.
3. C.T.Baldwin, "Fundamentals of Electrical Measurements".

Reference Books:

1. Deobelin, ‘Measurements Systems’, Tata McGraw Hill Publications, 2nd Edition, 2010.
2. John P.Bently, "Principles of Measurement Systems", 3rd edition.

EE603C	MICRO PROCESSORS AND MICROCONTROLLERS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: Digital Electronics

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Do assembly language programming.
2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
3. Understand the architecture and features of 8051 microcontroller.

UNIT-I

Development of microprocessors, 8086 microprocessor – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system and timings, Maximum mode 8086 system and timings.

UNIT-II

Assembler directives, Assembly language programs (8086) with Assembler directives for addition, subtraction, multiplication, division etc., sorting and searching, bit manipulation, Programs using look–up tables, Delay subroutines. Stages of software development.

UNIT-III

Data transfer schemes – Synchronous, Asynchronous, Interrupt driven and DMA type schemes, Programmable interrupt controller (8259) and its interfacing, Programmable DMA controller (8257) and its interfacing, Programmable Interval Timer (8253) and its interfacing, Programmable Communication Interface (8251 USART) and its interfacing.

UNIT-IV

Memory interfacing to 8086 – Interfacing various types of RAM and ROM chips, 8255 PPI andits interfacing, ADC and DAC Interfacing, Data acquisition, Waveform generation, Traffic light controller, Stepper motor control, temperature measurement and control.

UNIT-V

8051 Microcontroller – Architecture, register set, Instruction set, Interrupt structure, timer and serial port operations, Memory and I/O interfacing, Simple Assembly language programs.

Text Books:

1. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH.
2. Douglas V. Hall, "Microprocessors and interfacing: Programming and hardware", TMH,2nd edition.

3. Kenneth J Ayala, "The 8051 Micro Controller Architecture, Programming and Applications", Pernam International / Thomson Publishers, 2nd Edition, 2005.
4. Ajay V. Deshmukh, "Microcontrollers – theory applications", Tata McGraw-HillCompany

EE604C	UTILIZATION OF ELECTRICAL POWER	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. To provide students basic practical knowledge of illumination and to get general ideas aboutstreet lighting, building lighting.
2. To provide students' knowledge about the various electric heating methods and their advantages.
3. To make students to learn electrical welding methods and their advantages
4. To provide students basic practical knowledge of electric drives and to learn the characteristicsof different mechanical loads.
5. To provide students' knowledge about the electric traction & their advantages.

UNIT–I

Illumination: Nature of light, definitions, Laws of illumination, different types of lamps, construction and working of incandescent lamp, fluorescent lamp and discharge lamps, Illumination schemes; indoor and outdoor, Illumination levels. General ideas about street lighting,building lighting.

UNIT–II

Electric Heating: Advantages of electrical heating, Heating methods: Resistance heating, Induction heating, Electric arc heating, construction and working of arc furnace, Dielectric heating,Infra-red heating, Microwave heating, design problems of resistance heating element.

UNIT –III

Electric Welding: Advantages of electric welding, Welding methods, Principles of resistance welding, welding equipments used, Principle of electric arc welding, carbon arc, metal arc, hydrogen arc welding methods and their applications. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits.

UNIT –IV

Electric Drives: Introduction, Advantages of electric drives, Characteristics of different mechanical loads, Types of motors used in electric drive, types of braking, Methods of power transfer, selection of motors for different types of domestic loads.

UNIT –V

Electric Traction: Advantages of electric traction, Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves, pentagraph, Factors affecting

scheduled speed, types of motors used for electric traction, Starting and braking of traction motors.

Text Books:

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai &Sons, Delhi.
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana.
3. A.Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi.
4. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi.
5. Utilization of Electrical Energy by OS Taylor, Pitman Publications.
6. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, WileyEastern,Ltd., New Delhi

EE605C.i	ADVANCED CONTROL SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre Requisites: Linear Control Systems

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the need of compensators and controllers for design aspects
2. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
3. Understand the state space analysis and build system matrix for stability purpose.
4. Understand system Controllability and Observability.

UNIT- I

Compensators: Introduction to Compensators – Need for compensators – Types of Compensators - Lead, Lag, Lead lag compensators – Transfer function of compensators – Comparison of compensators – Applications of compensators.

UNIT- II

Controllers: Introduction to controllers – Need for controllers – Types of Controllers – Proportional, Integral and Derivative Controllers – Transfer function of controllers - PI, PD, PID Controllers – Design of controllers using frequency domain analysis – Comparison of controllers - Applications of controllers.

UNIT-III

State variable descriptions: Introduction – Comparison of advanced control theory and classical control theory – concepts of state, state variables, state vector, state space representation of physical systems – representation in state variable form, phase variables and canonical variables.

UNIT-IV

Controllability and Observability: Definition of controllability and Observability – Controllability and Observability tests for continuous time systems – Duality Principle of Controllability and Observability – Pole placement by state feedback design – State observers – Full order and reduced order observers

UNIT-V

Time response of linear system: Introduction – Solution of state equations – Homogenous and Non-homogenous – State Transition matrix – Properties of STM – Computation of STM

Non linear systems – Introduction – common physical non linearities – Dead Zone, Jump Resonance, Stiction, Friction, Hysteresis etc

Text Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
2. Benjamin C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. A Nagoor Khani, "Advanced Control Theory", CBS Publications, 2020.

EE605C.ii	ENERGY AUDITING AND MANAGEMENT	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre-Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines, Power systems-1

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand energy audit of industries and management of energy systems
2. Analyze the methods of improving efficiency of electric motors, power factor and design a good illumination system
3. Evaluate and analyze economic aspects of energy saving equipment

UNIT-I

Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-II

Basic Principles of Energy Audit: Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-III

Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT-IV

Power Factor Improvement, Lighting and Energy Instruments: Power factor – methods of improvement, location of capacitors, pf with nonlinear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT-V

Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. "Energy management", W.R. Murphy and G. Mckay Butter worth, Heinemann publications.
2. "Energy management", Paul o' Callaghan, Mc-graw Hill Book company-1st edition,1998

References:

1. "Energy efficient electric motors", John.C. Andreas, Marcel Dekker Inc Ltd-2nd edition,1995-
2. "Energy management hand book",W.C.Turner, John wiley and son
3. "Energy management and good lighting practice: fuel efficiency- booklet", 12-EEO

EE605C.iii	SPECIAL MACHINES	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Pre Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines

Course Outcomes: At the end of the course, student will be able to

1. Understand field aspects of electrical machines
2. Understand the operation and control of
   a. Stepper motors
   b. BLDC motors
   c. SR motor

UNIT-I

Field aspects of electrical machines: Review of Maxwell's equations and solution of Laplace's and Poisson's equations. Concept of magnetic vector potential. Eddy current braking. Linear motors: Basic principle of operation and types. End effects & transverse edge effects. Field analysis & Propulsion force; equivalent circuit.

UNIT-II

Stepper motors: Construction and operation of Stepper Motors: variable reluctance, permanent magnet, hybrid stepper motors, characteristics of stepper motors. Drive Circuits for Stepper motors: Block diagram of stepper motor controller, logic sequence generator, power drivers, current suppression circuits, and acceleration and deceleration circuits.

UNIT-III

Microprocessor control of stepper motors: microprocessor-based stepper motor controller, PC based stepper motor controller. Micro-stepping Control of Stepper motors: the micro-stepping principle, advantages of micro stepping, design of basic micro-stepping controller. Applications of stepper motor

UNIT-IV

Brushless DC motor: principle of operation of BLDC motor, square wave permanent magnet brushless motor drives, sine wave permanent magnet Brushless DC motor drives, phasor diagram, torque speed characteristics, controllers for BLDC motors, alternating current drives with PM andsynchronous reluctance hybrid motors.

UNIT-V

Switched Reluctance Motor Drives: Types of SR motors, principle of operation, static torque production, energy conversion loop, dynamic torque production. Converter Circuits, Control of SR motors: current regulation, commutation, torque speed characteristics, shaft position sensing.

Text Books:

1. "V .V.Athani, "Stepper Motors Fundamentals, Applications, and Design", New Age.
2. TJE Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives" Clarendon Press,Oxford .

EE607L	MICRO PROCESSORS AND MICROCONTROLLERS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Pre-Requisites: Micro Processors and Micro Controllers

Course Outcomes: At the end of the course, students will be able to:

1. Demonstrate program proficiency using the various instructions of the 8086microprocessor.
2. Demonstrate program proficiency using the various instructions of the 8051microcontroller
3. Design systems for different applications by interfacing external devices

LIST OF EXPERIMENTS

Part-1: 8086 programs:

1. Program to demonstrate data transfer operation
2. Program to demonstrate arithmetic operation
3. Program to demonstrate logical operation
4. Program to demonstrate shift operation
5. Program to demonstrate string operation
6. Program to demonstrate looping operation
7. Program to demonstrate decision making operations

PART-2: 8051 PROGRAMS:

1. Program to demonstrate data transfer and arithmetic operations
2. Program to demonstrate logical and shift operations
3. Program to demonstrate looping operations
4. Programming timer / counter.
5. Programming Serial communication application.
6. Programs to demonstrate bit-manipulation operations.

PART-3: INTERFACING PROGRAMS (using 8086 & 8051 Kits)

1. Interfacing ADC
2. Interfacing DAC.
3. Interfacing stepper motor.
4. Interfacing 7-segment display.
5. Interfacing Traffic light controller.
6. Waveform generation

EE608L	ELECTRICAL AND ELECTRONICS MEASUREMENTS LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Pre-Requisites: Electrical and Electronics Measurements

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Design and validate DC and AC bridges.
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand statistical data analysis.
5. Understand computerized data acquisition.

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter. Measurement of C using a bridge technique as well as LCR meter.
3. Measurement of Low Resistance using Kelvin's double bridge.
4. Measurement of High resistance and Insulation resistance using Megger.
5. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
6. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
7. Usage of DSO to capture transients like a step change in R-L-C circuit.
8. Current Measurement using Shunt, CT, and Hall Sensor.

EE609S	JAVA PROGRAMMING	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Pre Requisites: Basics of JAVA

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the software's for writing Java programming and code to accept an integer and print its factorial.
2. Develop the Java code for different applications.

List of Modules

1. Downloading and installing JDK and JRE. Executing simple java program which prints Hello world.
2. Program to accept an integer and prints its factorial.
3. Develop a java program to create class, which contains data and methods (private and public), create an object to access those members.
4. Develop a java program which demonstrates method over loading.
5. Develop a java program which demonstrates constructor and constructor over loading use this keyword.
6. Develop a java program which creates and Access Static and Non-static members of a class.
7. Develop the java program to study different methods provided in String and String Buffer classes.
8. Develop a java program that demonstrates single inheritance, use super keyword.
9. . Develop a java program for abstract class to find areas of different shapes.
10. Develop a java program to achieve multiple inheritance using interfaces.
11. Develop a java program to create an interface named Vehicle which contains two abstract methods. (Specifications (), Display ()). Provide two classes named Two- wheeler, Four-wheeler that is implemented by that interface.
12. Develop a java program to create a package and accesses it.
13. Develop a java program that demonstrates try, catch and finally.
14. Develop a java program that displays a frame with two Labels, two Text Fields and Two Buttons.

MC610A	PROFESSIONAL ETHICS IN ENGINEERING	0 Credits
Sessional Marks: **100**	**2L:0T:0P**	End Examination Marks: **NIL**

Pre-requisites/co-requisites: None.

COURSE OUTCOMES: At the end of the course, the student should be able to:

1. Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.
2. Learn the moral issues and problems in engineering; find the solution to those problems.
3. Learn the need for professional ethics, codes of ethics and roles, concept of safety, risk assessment.
4. Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights.

UNIT I

Human Values: Morals, values and Ethics – Integrity – Work ethic – Service learning –Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuingtime – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II

Engineering Ethics: Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Models of professional roles – Theories about right action – Self- interest – Customsand Religion – Uses of Ethical Theories.

UNIT III

Engineering as Social Experimentation: Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT-IV

Safety, Responsibilities and Rights: Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining– Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Right– Intellectual Property Rights (IPR)Discrimination.

UNIT V

Global Issues: Multinational Corporations – Business Ethics - Environmental Ethics – ComputerEthics - Role in Technological Development – Weapons Development – Engineers as Managers –Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct – Corporate Social Responsibility

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

VII - SEMESTER

EE701C	POWER SYSTEM PROTECTION	3 Credits
Sessional Marks :**40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of faults in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

UNIT–I

Protection against over voltages: Causes of over voltages-over voltages due to lightning –Rodgaps-Horn Gaps-Expulsion type and valve type lightning arresters-lightning arrester calculations- ground wires-counter poises-surge absorbers and surge diverters. Basics of Insulation coordination

- Power system earthing.

UNIT-II

Fuses: Definitions, characteristics, types, HRC fuses.

Circuit breakers: Introduction - Formation of Arcs in CBs - arc interruption theories - Definitions - Current chopping - Classification of circuit breakers - Oil circuit breakers- Air blast circuitbreaker - SF6 circuit breaker-Vacuum circuit breaker - Testing of circuit breakers.

UNIT–III

Protective Relaying fundamentals: Introduction – Need for protective systems in a power system – Zones of protection - Primary and backup protection – definition and functional characteristics of a protective relay – operating principles of various electromagnetic relays.

UNIT-IV

Types of Protective Relays: Overcurrent relays – Directional overcurrent relays – applications of over current relays. Distance relays: the universal torque equation – impedance, reactance and mhorelays - differential relays – percentage differential relays – Static relays.

UNIT–V

Generator Protection: Protection against stator faults, against rotor faults and against abnormalconditions.

Transformer Protection: Buchholz relay, differential protection, percentage

differentialprotection.

Busbar protection: - Frame leakage protection scheme

Text Books:

1. Badri Ram & D.N. Vishwakarma – Power system protection and switch gear., TMHpublishing Company Ltd. 1995.
2. C.L. Wadhwa – Electrical power systems, Wiley Eastern Ltd.
3. B. Ravindranath & M. Chander, power system protection & switch gear., Wiley EasternLtd.

EE702C.i	ELECTRICAL VEHICLES	3 Credits
Sessional Marks :**40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basics of electric vehicles, technical characteristics and properties ofbatteries and also to design battery pack.
2. Know the ratings and requirements of electrical machines.
3. Apply the regenerative braking and sizing of motors.
4. Configure and design the components of hybrid electric vehicles.

UNIT I

Electric Vehicles: Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II

Battery: Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III

DC & AC Electrical Machines: Motor and Engine rating, Requirements, DC machines, three phase A.C machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV

Electric Vehicle Drive Train: Transmission configuration, Components – gears, differential,clutch, brakes regenerative braking, motor sizing.

UNIT V

Hybrid Electric Vehicles: Types – series, parallel and series, parallel configuration – Design –Drive train, sizing of components.

Text book:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition,CRC Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons,2003.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals”, CRC Press, 2010.
2. Sandeep Dhameja, “Electric Vehicle BatterySystems”, Newnes, 2000http://nptel.ac.in/courses/108103009/

EE702C.ii	FLEXIBLE AC TRANSMISSION SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the working principles of FACTS devices and their operating characteristics.
2. Understand the working principles of static shunt and series compensation.
3. Understand the basic concepts of UPFC and IPFC
4. Understand the usage of Static voltage regulators and phase shifters

UNIT-I

Flexible Ac Transmission System: Transmission interconnections, flow of power in ac systems, loading capability, dynamic stability considerations, basic types of FACTS controllers.

UNIT-II

Static Shunt Compensators: Objectives of shunt compensation, static var compensators,STATCOM configuration, characteristics and control, comparison between STATCOM and SVC.

UNIT-III

Static Series Compensation: Objectives of series compensation, Variable Impedance type series compensators, switching converter type series compensators, external control for series reactive compensators.

UNIT-IV

UPFC: Principle of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the series compensators and phase angle regulators.

IPFC: Principle of operation and characteristics and control aspects.

UNIT-V

Static voltage regulators and phase shifters: Introduction**,** Principles of operation-Steady statemodel and characteristics - power circuit configurations

Text Books :

1. Hingorani ,L.Gyugyi,‘ Concepts and Technology of flexible ac transmission system’,IEEE Press New York, 2000.
2. K.R.Padiyar, “FACTS controllers in power transmission and distribution”, New ageInternational Publishers, Delhi, 2007.
3. R. Mohan Mathur and Rajiv K. Varma, ‘Thyristor - based FACTS controllers forElectrical transmission systems’, IEEE press, Wiley Inter science, 2002.

EE702C.iii	RESTRUCTURED POWER SYSTEMS	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of Restructuring of Power Industry
2. Understand the basics of Transmission Congestion Management
3. Understand the concepts of Locational Marginal Prices and Financial Transmission Rights
4. Understand the basics of Ancillary Service Management
5. Understand different pricing techniques of Transmission Network

UNIT I

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY Introduction: Deregulation of power industry, restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models

UNIT II

TRANSMISSION CONGESTION MANAGEMENT Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III

LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS

Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequency – FTR issuance process: FTR auction, FTR allocation — Flow gate rights – FTR andmarket power

UNIT IV

ANCILLARY SERVICE MANAGEMENT Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service

UNIT V

PRICING OF TRANSMISSION NETWORK Transmission pricing – Principles –Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm - Composite pricing paradigm – Merits and demerits of different paradigm.

Text Books / References:

1. Sally Hunt," Making competition work in electricity", , John Willey and Sons Inc. 2002
2. Steven Stoft," Power system economics: designing markets for electricity", John Wiley &Sons, 2002.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electricalpower systems: operation, trading and volatility" Pub., 2001
4. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen," Operation of restructured powersystems", Kluwer Academic Pub., 2001.

EE703C.i	POWER SYSTEM OPERATION AND CONTROL	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand economic operation and analyze methods for unit commitment of power systems.
2. Analyze voltage control and frequency regulation methods.
3. Realize stability issues and reactive power compensation.

UNIT-I

Economic operation of power systems: Introduction – operating cost of a thermal plant –Economic dispatch neglecting losses and no generation limits –Economic dispatch including losses - derivation of loss formula - Hydroelectric power plant model – Scheduling of hydropower plant.

UNIT-II

Unit commitment and optimal power flow constraints of unit commitment problem – Solution methods of unit commitment – priority list methods – Dynamic programming approach to solve the unit commitment problem - optimal power flow solution – Elementary treatment of optimal power flow with and without constraints

UNIT-III

Load frequency control: The load frequency control problem – Basic P-f and Q-V control loops of a synchronous generator – Governor model- prime mover model – Generator model – Load model – concept of Single & Multi area power systems – Block diagrams representation of an isolated single area power system – steady state and dynamic responses of uncontrolled and proportional plus integral control of single area power system – load frequency control of two-areapower system – Tie line bias control.

UNIT-IV

Automatic voltage regulator – introduction - modeling of amplifier, exciter, Generator and sensor – A simplified AVR block diagram – Excitation system stabilizer – Rate feedback and PID controller – automatic excitation generation control with system – placement and optimal feed- back design.

UNIT-V

Voltage stability and reactive power control- voltage stability problems in a power system –over flow of reactive power control – control of reactive power flow on a line – load compensation
– specification of load compensator – uncompensated and compensated transmission lines

Text Books:

1. "Power system analysis" by Hadi Saadat, Tata Mc Grawhill International.
2. "Modern power system analysis" by J. Nagarath & DP Kothari, Tata Mc Grawhill secondedition
3. "Power system analysis and design" by B.R. Gupta wheeler publishing
4. "Electrical energy system theory" by O.I. Elgerd Tata Mc Grawhill Ltd second edition.

EE703C.ii	POWER SEMICONDUCTOR CONTROLLED DRIVES	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the fundamental concepts of electrical drives.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

UNIT-I

Electrical Drives – An introduction – Electrical Drives, Advantages of Electrical Drives, parts of electrical drives – Electrical motor, power modulators, sources, control unit, choice of electricaldrives, status of dc and ac drives.

Dynamics of Electrical Drives – Fundamental Torque equations, speed torque convention and multi quadrant operation, Equivalent values of drive parameters – Loads with rotational motion, loads with translational motion, measurement of moment of inertia. Components of load torques, Nature and classification of load torques, calculation of time and energy loss in transient operation,steady state stability, load equalization.

UNIT-II

Control of electrical drives – Modes of operation, speed control and drive classifications closedloop control of drives.

D.C. Motor drives – Starting, Braking, speed control - Armature voltage control, Ward Leonard drives, controlled rectifier fed DC drives – Single phase and 3-phase fully controlled and half controlled converter fed separately excited D.C. Motor, Chopper Controlled DC drives. (separatelyexcited motor).

UNIT-III

Induction Motor Drives: Review of three phase I.M., analysis and performance. Operation with unbalanced source voltages and single phasing, analysis of I.M. fed from non-sinusoidal voltage supply. Starting, Braking, methods

UNIT-IV

Speed control methods of IM, v/f controlled induction motors, controlled current and controlled slip operation, PWM inverter drives, Multi-quadrant drives and field oriented control, slip power control, single phase I.M. Close loop control of I.M. Drives.

UNIT-V

Synchronous motor drives: cylindrical rotor wound field motor, Salient pole wound field motor, Synchronous reluctance motor, Hysteresis synchronous motor, Operation from fixed frequency supply, starting, braking, synchronous motor, variable speed drives,

starting large synchronous machines.

Energy Conservation in electrical drives – Losses in electrical drive system, measures of energy conservation in electrical drives, use of efficient converters, energy efficient operation of drives, improvement of p.f., improvement of quality of supply, maintenance of motors.

Text Books:

1. G.K.Dubey – Fundamentals of Electrical drives.
2. Vedam Subrahmanyam - Electrical drives – Concepts and applications.

EE703C.iii	POWER QUALITY	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of power quality.
2. Understand the basic concepts of voltage variations and transients
3. Understand different harmonics in power systems
4. Understand the working of Power quality conditioners

UNIT –I

Electric power quality phenomena- IEC and IEEE definitions - power quality disturbances-voltage fluctuations – transients – unbalance - waveform distortion - power frequency variations.

UNIT–II

Voltage variations- Voltage sags and short interruptions – flicker-longer duration variations - sources – range and impact on sensitive circuits-standards – solutions and mitigations – equipment and techniques.

UNIT–III

Transients – origin and classifications – capacitor switching transient – lightning-loadswitching – impact on users – protection – mitigation.

UNIT –IV

Harmonics – sources – definitions & standards – impacts - calculation and simulation –harmonic power flow - mitigation and control techniques – filtering – passive and active.

UNIT–V

Power Quality conditioners – shunt and series compensators- DStatcom- Dynamic voltagerestorer-unified power quality conditioners-case studies.

Text Books:

1. Bollen,M.H.J., 'Understanding Power Quality Problems: Voltage sags and interruptions', IEEE Press, New York, 1999.
2. Arrillaga, J, Watson, N.R., Chen, S., 'Power System Quality Assessment', Wiley, New York, 1999.
3. Heydt, G.T., 'Electric Power Quality', Stars in a Circle Publications, Indiana, 1991.

EE704C.i	HVDC TRANSMISSION	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Differentiate between AC and DC transmission, their advantages and applications
2. Analyze HVDC converters and converter bridge characteristics
3. Understand the particulars of converters and HVDC system control and reactive powercontrol
4. Identify Converter faults and protection carried.
5. Understand harmonics, filters and different multi terminal systems

UNIT-I

DC Power Transmission Technology:
Introduction, Comparison of AC DC transmission, Converter station, Description of DC Transmission systems, Components of a HVDC system. Choice of voltage level, Modern trends in DC transmission

UNIT-II

Analysis of HVDC Converters:
Pulse number, Choice of converter configuration, valve rating. Transformer, simplified analysis of graetz circuit with and without overlap (2 and 3 valve conduction mode) rectifier and inverter waveforms, converter bridge characteristics

UNIT-III

Converter and HVDC System Control:
Principle of DC Link control, Converter control characteristics, system and control hierarchy, firing angle control, converter and excitation angle control, starting and stopping of DC Link,Power control, Sources of reactive power, static var systems.

UNIT-IV

Converter Faults:
Protection against over currents, over voltages in converter station, surge arresters, protection against over voltages
Smoothing reactor, DC Line, Transient over-voltages in DC line, protection of DC line, DCbreakers.

UNIT-V

Generation of Harmonics, Design of AC Filters, Dc Filters, Carrier frequency and RI noise. **MTDC Links** Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text Books:

1. K R Padiyar, “HVDC Transmission Systems”
2. S. Rao, “EHV AC and HVDC Transmission engineering and Practice”
3. J.Arrillaga, “High Voltage Direct Current Transmission”, Peter Peregrinus Ltd.,1983.
4. E.W.Kimbark, “Direct Current Transmission”, Vol.1, Wiley-Interscience,1971.

EE704C.ii	HIGH VOLTAGE ENGINEERING	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, the student will demonstrate

1. Understand the basic physics related to various breakdown processes in solid, liquid andgaseous insulating materials.
2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
3. Knowledge of how over-voltages arise in a power system, and protection against theseover-voltages.

UNIT-I

Breakdown in solid, liquid and gas insulating materials

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT-II

Generation of High Voltages

Generation of high voltages, generation of high D. C. and A.C. voltages - Van de Graff Generator, Cockcroft Walton Voltage multipliers, Cascade transformer circuits, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT-III

Measurements of High Voltages and Currents

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillo graphs for impulse voltage and current measurement, measurement of dielectric constant and lossfactor, partial discharge measurements.

UNIT-IV

Lightning and Switching Over-voltages

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over- voltages, Protection against over-voltages, Surge diverters, and Surge modifiers.

UNIT-V

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books:

1. M.S. Naidu and V. Kamaraju, "High Voltage Engineering", Mc Graw Hill Education, 2013.
2. C. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D.V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers,1993.
4. E. Kuffel, W.S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", NewnesPublication, 2000.
5. R.Arora and W.Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons,2011.Various IS standards for HV Laboratory Techniques and Testing

EE704C.iii	SMART GRID	3 Credits
Sessional Marks: **40**	**3L:0T:0P**	End Examination Marks: **60**

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand smart grids and analyze the smart grid policies and developments in smart grids.
2. Develop concepts of smart grid technologies and their applications.
3. Analyze micro grids, distributed generation systems, the effect of power quality in smart gridand understand latest developments in ICT for smart grid.

UNIT – 1

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT – 2

Smart Grid Technologies-I: Introduction to Smart Meters, Real Time Prizing, Smart Appliances,Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase ShiftingTransformers.

UNIT – 3

Smart Grid Technologies-II: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT – 4

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications ofmicrogrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT – 5

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and RenewableEnergy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and DemandResponse", CRC Press

Reference Books:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "SmartGrid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley Blackwell 19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of ElectricUtilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks."Institution of Engineering and Technology, 30 Jun 2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press 6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

EE707 L	POWER SYSTEM SIMULATION LAB	1.5 Credits
Sessional Marks: **40**	**0L:0T:3P**	End Examination Marks: **60**

Pre-requisites: Power systems-II, Power System Analysis, Power System Operation and Control,Power System Protection

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze transmission systems under steady state and transient conditions
2. Perform fault calculation and network protection
3. Understand the performance of renewable energy systems

LIST OF EXPERIMENTS

1. Determination of Receiving end quantities and the line performance of a medium/longtransmission line using simulation tool.
2. Using Computer code determine:
   i. Bus admittance matrix by inspection method for a 3-bus power system and obtain
   ii. Power flow solution by Newton-Raphson method.
3. Determination of Sequence components (Positive, Negative and Zero) of an alternatorusing simulation tool.
4. Transient analysis of a Single Machine Infinite Bus (SMIB) system using simulation tool.
5. Simulation of LG, LL, LLG and LLL faults on a simple power system.
6. Determine steady state frequency error and frequency deviation response for an
   i. Isolated power system and
   ii. Interconnected power system.
7. Plot the Swing curve for a simple 3 or 4 bus power system using Simulation Tool.
8. Study the Over current protection scheme using numerical relay.
9. Determination of ABCD parameters and performance of a transmission line
10. Determination of Positive, Negative and Zero sequence reactance for a 3-phase alternator

Additional Experiments

1. Plot V-I characteristics of Solar panel at various levels of insolation.
2. Study the performance of a Wind turbine system at different wind speeds and plot thecharacteristics.
3. Determination of Earth resistance in humid and dry earth conditions.

EE708 S	IOT LAB	2 Credits
Sessional Marks: **40**	**1L:0T:2P**	End Examination Marks: **60**

Course Outcomes: At the end of the course, the student will be able to:

1. Control different electrical and electronics applications using Arduino
2. Control different electrical and electronics applications using Raspberry Pi

List of Experiments

1. Interfacing LED, Push button using Arduino.
2. Interfacing DHT11- Temperature and humidity sensor using Arduino.
3. Interfacing Ultrasonic sensor using Arduino.
4. Interfacing PIR sensor using Arduino.
5. Design of Traffic Light Simulator using Arduino.
6. Interfacing RFID using Arduino/ Raspberry Pi
7. Interfacing of LED, Push button with Raspberry Pi (Python Program).
8. Design of Motion Sensor Alarm using PIR Sensor.
9. Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi.
10. Implementation of DC Motor and Stepper Motor Control with Raspberry Pi.

Project based experiments:

1. Raspberry Pi based Smart Phone Controlled Home Automation.
2. Smart Traffic light Controller.
3. Smart Health Monitoring System.

HONORS

EEHN01	ELECTRICAL MACHINE DESIGN	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the construction and basic design of transformers
2. Understand the design of rotating machines
3. Understand the design of 3-phase Induction motor
4. Understand the design of synchronous machines.
5. Analyze the Heating and Cooling of Electrical Machines.

UNIT-I

The design Problem: Basic considerations, design specifications, IS specifications, design constraints, design specifications for transformers and rotating machines Design of transformers: Types of core constructions, output equation, principles of design of core, windings, yoke, estimation of main dimensions (H & W) for single phase shell type, core type and 3-phase core type transformers Estimation of no-load current from design data

UNIT-II

General Concepts for design of rotating machines: Output equation of dc and ac machines, separation of D and L, Choice of specific loadings Design of dc machines: Choice of number of poles, selection of number of armature slots, choice of armature winding, design of armature, design of commutator Design of field system: tentative design of field system, estimation of filed current

UNIT-III

Design of 3-phase Induction motor: separation of D and L, ranges of specific loadings Stator Design, selection of number of slots, estimation of turns per phase, design of conductor cross section Rotor design: Selection of number of rotor slots, principles of design of squirrel cage and slip ring rotor

UNIT-IV

Design of synchronous machines: Choice of armature windings, types of armature windings, separation of D and L Design of armature, choice of number of slots, estimation of turns per phase conductor cross section, field system design for salient pole and cylindrical pole rotor machines

UNIT-V

Heating and Cooling of Electrical Machines: Estimation of temperature rise, heating time constant, cooling time constant, heating and cooling time curves, volume of coolant required **Design of transformer tank with tubes**: estimation of temperature rise, design of transformer tank

TEXT BOOKS:

1. A.K.Sawhney, “Electrical Machine Design” (Dhanpatrai & Sons)
2. Balbir Singh, “Electrical Machine Design”(Khanna Publishers)

EEHN02	ADVANCED POWER SYSTEM PROTECTION	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Learn the importance of static relays.
2. Apply appropriate comparator
3. Learn about digital protection

UNIT: 1

Static Relays: Fundamentals of static relays, Basic Block diagram and principle, Advantages of Static Relays, Types of static relays, Static Over-current relays, Differential relays, Percentage Differential relays, distance relays, characteristics of static relays.

UNIT: 2

Comparators: Need of comparators, General Equations of Comparators, Phase and amplitude Comparators, Analysis of Amplitude and Phase Comparators, Operating principles, Pilot relaying and Carrier current protection schemes, Multi Input Comparator circuits

UNIT: 3

Protection of Transmission lines & Transformers: Classification of protection schemes, zones of protection, 3–zone protection schemes, carrier aided distance schemes, switched distance schemes, Transformer protection, mal operation of relays, Harmonic Restraint relay, Wavelet applications in transformer protection, realization of Elliptical and Quadrilateral characteristics

UNIT: 4

Basic elements of Digital Protection: Historical Developments in digital protection, performance and operational characteristics of digital protection, basic structure of digital relays, components of digital relay, signal conditioning subsystem, conversion subsystem, digital relay subsystem

UNIT: 5

Digital Protection Of Power System Components: New developments in relaying principles, Generator protection, Transmission lines protection, transformer protection, protection of bus bars, fundamentals of travelling wave protection and applications

Text Books:

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
4. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014 5. Electrical Power Systems – C.L. Wadwa

EEHN03	DIGITAL CONTROL SYSTEMS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Identify the basic difference between continuous and digital time control.
2. Evaluate the stability of a system under different placements.
3. Design the digital controllers for industrial applications.
4. Analyze the discrete time systems with state space analysis techniques.

UNIT – I

Introduction – Comparison between analog and digital control – Importance of digital control – Structure of digital control – examples of digital control system – Difference equations – Z – transform – MATLAB examples. Frequency response of discrete-time systems – Properties of frequency response of discrete-time systems – Sampling theorem.

UNIT – II

ADC model – DAC model – Transfer function of zero order hold – DAC – Analog Subsystem, and ADC Combination Transfer Function – Closed loop transfer function – Steady state error and its constants (MATLAB commands).

UNIT – III

Definitions of stability (Asymptotic stability, exponential stability etc) – stable z-domain pole placement locations – stability conditions – Stability determination (Routh array) – Nyquist criterion.

UNIT – IV

Root locus – root locus design (P-control, PI -control, PD) – Z - domain root locus – z-domain root locus design digital implementation of analog controller design (differencing methods forward and backward) – bi linear transformation – direct z-domain controller design – frequency response design – Finite time response settling time.

UNIT – V

Concept of state space method – state space representations of discrete time systems – solving discrete time state space equations – Pulse transfer function matrix – Discretization of continuous state space equations – Liapunov stability analysis (discrete time) Controllability – observability – design via pole placement – state observers.

Text Books:

1. Kannan M. Moudgalya, 'Digital Control', Wiley Publishers, 1st Illustrated Edition, 2007.
2. M.Gopal, 'Digital Control Engineering', New Age International (ltd) Publishers, 1st Edition Reprint (2003), 1998.
3. Katsuhiko Ogata, 'Discrete Time Control Systems', Pearson Education Publications, 2nd Edition, 2005.

EEHN04	ADVANCED POWER ELECTRONICS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of the course, students will be able to

1. Learn the characteristics of GTOs, IGBTs and use them in practical systems
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo- converters and PWM techniques and the ability to use them properly
3. Acquire knowledge of power conditioners and their applications
4. Ability to design power circuit and protection circuit of PSDs and converters

UNIT-I

High-Power Switching Devices: Gate Turn-Off (GTO) Thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), Other Switching Devices, Operation of Series- Connected Devices Main Causes of Voltage Unbalance, Voltage Equalization for GCTs, Voltage Equalization for IGBTs

UNIT-II

Two-Level Voltage Source Inverters: Introduction, Sinusoidal PWM, Modulation Schemes, Harmonic Content Over-modulation, Third Harmonic Injection PWM, Space Vector Modulation Switching States, Space Vectors, Dwell Time Calculation, Modulation Index Switching Sequence, Spectrum Analysis, Even-Order Harmonic Elimination, Discontinuous Space Vector Modulation

UNIT-III

Cascaded H-Bridge Multilevel Inverters: Introduction, H-Bridge Inverter Bipolar Pulse-Width Modulation, Unipolar Pulse-Width Modulation, Multilevel Inverter Topologies, CHB Inverter with Equal dc Voltage, H-Bridges with Unequal dc Voltages, Carrier Based PWM Schemes, PWM Schemes, Staircase Modulation

UNIT-IV

Diode-Clamped Multilevel Inverters : Three-Level Inverter, Converter Configuration, Switching State, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted Commutation, Space Vector Modulation, Stationary Space Vectors, Dwell Time Calculation, Relationship Between *Vref,* Location and Dwell Times Switching Sequence Design, Inverter Output Waveforms and Harmonic Content, Even-Order Harmonic Elimination, Neutral-Point Voltage Control, Causes of Neutral-Point Voltage Deviation, Effect of Motoring and Regenerative Operation, Feedback Control of Neutral- Point Voltage

UNIT-V

Other Space Vector Modulation Algorithms: Discontinuous Space Vector Modulation, SVM Based on Two-Level Algorithm, High-Level Diode-Clamped Inverters, Four- and Five-Level Diode-Clamped Inverters, Carrier-Based PWM, NPC/H-Bridge Inverter: Inverter Topology, Modulation Scheme, Waveforms and Harmonic Content

Text Books:

1. Bin Wu ," High Power Converters and AC Drives (IEEE Press 2008)
2. By Dorian O Neacsu, " Power Switching Converters: Medium and High Power"

EEHN05	HYBRID ELECTRICAL VEHICLES	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basics and configurations of electric vehicles and hybrid electric vehicles.
2. Analyze the power converters used in hybrid electric vehicles
3. Know different batteries and other energy storage systems.

UNIT– 1

Introduction: History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT– 2

Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle and propulsion load, Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle, Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV, Fuel Cell vehicles and its constituents.

UNIT– 3

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT– 4

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– 5

Battery and Storage Systems: Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource Course.

Text Books:

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction –DhanpatRai& Co, 2007.
4. Pistooa G., "Power Sources, Models, Sustainability, Infrastructure and the market", Elsevier 2008
5. Mi Chris, Masrur A., and Gao D.W., "Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives" 1995.

EEHN06	INDUSTRIAL APPLICATIONS OF ELECTRICAL ENGINEERING	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Select appropriate wiring components for electrical safety practices.
2. Design the HT connection with appropriate protection and compensations for Industrial, Residential and commercial applications.
3. Evaluate and select an appropriate motor to a particular application.
4. Design a lightning scheme for interior and exterior illumination application.

UNIT-I

Components in Electrical Systems: LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

UNIT – II

Industrial Electrical Systems: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction - kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT – III

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT – IV

Special-Purpose Motors: Textile motors, Crane motors, determining the size of motor, Sugar centrifuge motors, Motors for deep-well pumps, Motors for agricultural application, Motors for mines, collieries and quarries, Motors for thermal power station auxiliaries, Selection of a special- purpose motor.

UNIT – V

Illumination Systems: Production of light, Laws of illumination, lighting calculation, Interior and exterior illumination systems, lighting schemes, design on lighting scheme; Electrical lamps, factory lighting, flood lighting, gaseous discharge lamps, high pressure and low-pressure neon lamps, high frequency, low pressure discharge tubes, induction lamps, LED lamps, Simple problems.

Text Books:

1. S. L. Uppal and G. C. Garg," Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2. K. B. Raina," Electrical Design, Estimating & Costing", New age Inter- national, 2007.
3. S. Singh and R. D. Singh," Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4. H. Joshi," Residential Commercial and Industrial Systems", McGraw Hill Education, 2008
5. K.C.Agarwal "Industrial Power Engineering and Applications Handbook", Newnes Power Engineering Series., 2001

MINOR

EEMN01	ELECTRICAL CIRCUITS AND NETWORKS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand pre requisites of Electric circuits
2. Apply network theorems for the analysis of electrical circuits.
3. Understand and Analyze AC Circuits

UNIT-1

Elementary Concepts: Prerequisite: Concept of Potential difference. Current and resistance. Ohm's law, effect of temperature on resistance, resistance temperature coefficient, insulation resistance. SI units of work Power and Energy. Conversion of energy from one form to another in electrical and thermal systems.

UNIT -2

D. C. Circuits: Kirchhoff's law, ideal and practical voltage and current sources. Mesh and Nodal analysis (Super node and super Mesh excluded). Source transformation. Star delta transformation. Superposition theorem, Thevevnins's theorem Norton's theorem, maximum power transfer theorem (Source transformation not allowed for superposition theorem, Mesh and Nodal analysis.

UNIT- 3

A.C. Fundamentals: Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor, and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Study of A.C circuits of pure resistance, inductance and capacitance and corresponding voltage- current phasor diagrams, voltage – current and power waveforms.

UNIT- 4

Single phase AC Circuits: Study of series and parallel R-L, R-C, R-L-C circuits, concept of impedance and admittance for different combinations, wave form and relevant voltage current phasor diagrams. Concept of active, reactive, apparent, complex power and power factor, resonance in series and parallel RLC circuit. Q-factor and bandwidth

UNIT- 5

Polyphase AC circuits: Concept of three phase supply and phase sequence. Balanced and unbalanced loads voltage current and power relations in three phase balance star and delta loads and their phasor diagrams.

Text Books:

1. Engineering Circuit Analysis William H Hayt et al Mc Graw Hill 8th Edition, 2014
2. Network Analysis M.E. Vanvalkenburg Pearson 3rd Edition , 2014
3. Fundamentals of Electric Circuits Charles K Alexander Matthew N O Sadiku Mc Graw Hill 5thEdition,2013

Reference Books:

1. Engineering Circuit Analysis J David Irwin et al Wiley India 10th Edition, 2014
2. Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition, 2009
3. Introduction to Electric Circuits Rich ard C Dorf and James A Svoboda Wiley 9th Edition, 2015
4. Circuit Analysis ; Theory and Practice Allan H Robbins Wilhelm C Miller Cengage 5th Edition,2013
5. Basic Electrical Engineering V K Mehta, Rohit Mehta S Chand 6th Edition 2015

EEMN02	ELECTRICAL MACHINES	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of the course, students will be able to

1. Understand different types of DC generators, Motors
2. Analyze and understand performance aspects of various testing methods of DC Machine
3. Understand Transformers, their construction, operation and applications.
4. Understand the operation of AC machine
5. Analyze performance characteristics of AC machines

UNIT- I

D.C. Generators – Principle of Operation – Constructional Features – E. M.F Equation– Numerical Problems – Methods of Excitation – Separately Excited and Self Excited Generators – Build-Up of E.M.F - Critical Field Resistance and Critical Speed - Load Characteristics of Shunt, Series and Compound Generators- Applications.

UNIT – II

D.C Motors – Principle of Operation – Back E.M.F. –Torque Equation – Characteristics and Application of Shunt, Series and Compound Motors-Speed Control of D.C. Motors: Armature Voltage and Field Flux Control Methods. Three Point Starter-Losses – Constant & Variable Losses – Calculation of Efficiency - Swinburne's Test.

UNIT-III

Single Phase Transformers - Constructional Details- Emf Equation - Operation on No Load and on Load - Phasor Diagrams-Equivalent Circuit - Losses and Efficiency-Regulation-OC and SC Tests – Sumpner's Test - Predetermination of Efficiency and Regulation.

UNIT-IV

Polyphase Induction Motors-Construction Details of Cage and Wound Rotor Machines- - Principle of Operation – Slip- Rotor Emf and Rotor Frequency – Torque Equation- Torque Slip Characteristics.

UNIT – V

Principle And Constructional Features of Salient Pole and Round Rotor Machines – E.M.F Equation- Voltage Regulation by Synchronous Impedance Method- Theory of Operation of Synchronous Motor.

TEXT BOOKS:

1. Electric Machines –by I.J.Nagrath & D.P.Kothari,Tata Mc Graw Hill, 7 th Edition.2005
2. Basic Electrical Engineering –By T.K. Nagasarkar and M.S. Sukhija Oxford University Press.

REFERENCE BOOKS:

1. Electrical and Electronic Technology, Hughes, Pearson Education.
2. Electrical Machines, P. S. Bimbhra, Khanna Publishers, 2011.
3. Basic Electrical Engineering, 2 nd Edition, V.N. Mittle and Aravind Mittal, Mc Grawhill Education, 2006.

EEMN03	POWER SYSTEMS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will be able to

1. Analyze Economic aspects of power stations
2. Understand the concepts of AC Distribution and Substations of power systems.
3. Study and analyze Overhead line insulators and Underground cables

UNIT–I

Fundamentals of Power Systems: Evolution of Power Systems-Present day Scenario-Structure of Power Systems-Conventional & Renewable Energy Sources
Power Stations: Hydro-electric, Thermal Stations, Gas Turbine and Nuclear Power stations- Selection of Site, Main parts, layout and working principle, Basics of Renewable Energy Sources

UNIT–II

Economic aspects of power stations- Types of loads-Load curve, load duration and integrated load duration curves-Load factor-Demand factor-Diversity factor-Capacity factor-Utilization and plant use factors. The effect of these factors on generation-Number and size of generating units- Base load and peak load plants-Costs of electrical energy-Types of tariff charges on consumers

UNIT–III

AC Distribution: Comparison of AC single phase, 3 phase 3 wire and 3 phase 4 wire systems with DC 2 wire-Types of primary distribution systems-Types of secondary Distribution systems-AC distributors fed at one end and at both ends-Kelvin's Law-Limitations of Kelvin's Law-Load Estimation-Selection voltage of primary distribution-Choice of scheme-Size of feeders, power factor correcting methods.

UNIT-IV

Substations: Number and size-Location and installation-The main equipment in substations-Busbar Arrangements-Key diagram of a typical primary substation.
Overhead line insulators: Introduction-Types of insulators-Potential distribution over a string of insulators-Methods of equalizing the potential, string efficiency-Testing of insulators.

UNIT-V

Underground Cables: Introduction-The insulation types-Insulating materials for EHV voltage cables-Classification of cables - Parameters of single core cable-Grading of cables-Capacitance of three core belted cable break down of cables-Heating of cables – dielectric loss and Sheath losses- Current rating of cables.

Text Books:

1. C.L. Wadhwa, "Electrical Power systems" New age publications.
2. B.R. Gupta, "Power system analysis and design" third edition, Wheeler publishing.
3. William D. Stevenson "Elements of power system analysis" fourth edition, Mc

Grawhill International editions.

Reference Books:

1. C.L. Wadhwa, "Generation Distribution and utilization of Electrical energy", New Age International
2. AR Bergen and Vijay Vittal, "Power system analysis", Pearson education, 2001

EEMN04	CONTROL SYSTEMS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Understand the applications of control systems in industries.

UNIT–I

Introduction to Control systems: Scope of Control System Engineer – Classification of Control System – Historical development of Control system – System representation – Control system technologies – Types of control Systems: open loop and closed loop systems - Advantages and disadvantages of control systems – Examples of open loop and closed loop control systems.

UNIT-II

Mathematical modeling of physical systems: Transfer function and limitations – Mathematical modeling and transfer functions of electrical, mechanical systems – Electrical analogues – Block diagram reduction techniques – signal flow graph and Mason's gain formulae.

UNIT-III

Time domain analysis: Standard test input signals – step response of first and second order systems – Time domain specifications – Problems.

Introduction to stability – Necessary conditions for stability – Characteristic equation and location of roots in s-plane for stability – R-H stability Criterion.

UNIT-IV

Frequency domain analysis: Introduction to frequency domain – Frequency Domain Specifications – Correlation between time domain and frequency domain responses – Frequency response plots – Polar plots – Bode plots.

Non linear systems – Introduction – Common physical non-linearities – Dead Zone, Jump Resonance, Friction, Hysteresis etc.

UNIT-V

Introduction to Compensators – Need for compensators – Types of Compensators – Transfer function of compensators – Comparison of compensators.

Controllers: Introduction to controllers – Need for controllers – Types of Controllers – Transfer function of controllers – Comparison of controllers.

Text Books:

1. I.J.Nagrath and M.Gopal, "Control system Engineering", Wiley Eastern Ltd.
2. Benjamin C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. Ch. Chengaiah and G.V Maruteswar, "Control Systems A comprehensive Lab Manual", B.S. Publications, 2017.
4. A Nagoor Khani, "Advanced Control Theory", CBS Publications, 2020.

EEMN05	POWER ELECTRONICS	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand the differences between signal level and power level devices.
2. Analyze controlled rectifier circuits.
3. Analyze the operation of DC-DC choppers.
4. Analyze the operation of voltage source inverters.

UNIT-I

Silicon controlled Rectifier – Static characteristics and ratings – turn- ON and turn-OFF mechanism – Gate characteristics – Series and parallel operation of SCR's static and dynamic equalization circuits – Protection circuits – Design of snubber circuit – Class A, B, C, D, E types of commutation circuits.

UNIT-II

Phase controlled Rectifiers - Principles of phase control – Half-wave and full- wave controlled rectifiers with resistive, inductive and RLC load – Freewheeling diode operation – Bridge rectifiers – Single phase and three phase Rectifiers with inductive load – Half and fully controlled rectifiers – freewheeling diode operation – Effect of source inductance –
Dual converter – circulation and non-circulating current mode of operation.

UNIT-III

Choppers – D.C. Choppers – Principles of operation – control strategies, constant and variable frequency system, current limit control – Types of chopper circuits – Type-A, Type B and Type E chopper circuits Morgan chopper Jone's chopper

UNIT-IV

Inverters – Classification – series and parallel inverters improved series inverters – Bridge inverters – Commutation circuits – current and voltage commutation circuits – single phase and three phase inverters – output waveform control – Mc Murray Inverter – Introduction to PWM techniques

UNIT-V

Cyclo-converters – Principle of operation – single phase step-up and step down cycloconverters – Three-phase half-wave cycloconverters – output voltage equation – circulation and non- circulating current mode of operation – Load commutated cycloconverter.
Speed control – Speed control of DC motors using controlled rectifiers and choppers – Speed control of induction motors using inverters

Text Books:

1. An introduction to Thyristors and their application – Dr.M.Ramamoorthy – East West press.
2. Power Electronics - Dr. P.S .Bimbhra 2nd edition – Khanna publishers.
3. Power Electronics – M.D. SINGH and K.B. KHANCHANDANI – Tata Mc.Graw Hill publishers.
4. Industrial and Power Electronics – RASHID (3rd Edition)

EEMN06	ELECTRONICS ENGINEERING	4 CREDITS
Sessional Marks: 40	3L:1T:0P	End Examination Marks: 60

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Analyze the general – and special-Purpose diode circuits
2. Design biasing circuits for BJT
3. Analyze BJT Circuits in small-signal domain
4. Analyze basic FET Circuits
5. Verify the functionalities of basic digital gates and logic families

UNIT-1

DIODE THEORY AND APPLICATIONS Basic idea about forward bias, reverse bias and VI characteristics, ideal diode, surface mount diodes, Zener diode, half wave rectifier, full wave rectifier, bridge rectifier, RC and LC filters, Design of un-regulated DC power supply, clipping circuit, Clamping circuit, voltage multiplier circuit.

Light emitting diode (LED). Zener diode, Zener diode circuit for voltage regulation, Photo diode, Solar cell, PIN diode, Varactor, Schottky diode, Varistors, Tunnel diode

UNIT-2

BIPOLAR JUNCTION TRANSISTORS AND ITS BIASING BJT operation, BJT voltages and currents, CE, CB and CC characteristics, DC load line and bias point, base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal stability, biasing BJT switching circuits, transistor power dissipation and switching time

UNIT-3

AC ANALYSIS OF BJT CIRCUITS AND SMALL SIGNAL AMPLIFIER Coupling and bypass capacitors, AC load lines, Transistor models and parameters, Common emitter circuit analysis, common base circuit analysis, common collector circuit analysis, Comparison of CE, CB and CC circuits, Transistor as a switch

UNIT-4

Field effect transistors (FET) and its biasing Junction field effect transistors (JFET), Comparison of BJT and FET, JFET characteristics, FET, biasing in ohmic region and active region, Trans- conductance, amplification and switching, MOSFETs (D-type and E-type MOSFET), CMOS introduction

UNIT-5

Digital Circuits Basic gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Building AND, OR Gate with diodes, Digital logic families RTL, DTL, TTL, CMOS, Comparison of logic families

Text Books:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, Fifth edition
2. Albert Malvino & David, “Electronic Principles”, Tata McGraw-Hill, Seventh edition
3. R. L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education

Reference Books:

1. Jaccob Millman, Chritos Halkias, Chetan D Parikh, “Integrated Electronics”, Tata McGraw-Hill, Second edition
2. Albert Malvino & David, “Problems and Solutions in Basic Electronics, McGraw Hill Education